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ANNOUNCEMENTS.

FEILDEN'S MAGAZINE is published at the *beginning* of every month.

In consequence of the large number of pages to be prepared and passed for press, the careful nature of the printing required for high-class production, the advance arrangements made for extensive circulation, and in order to facilitate departmental business, observance of the following rules is necessary :—

Literary Matter to reach the offices not later than the 15th of the month (as much earlier as possible) previous to date of publication. Communications to be addressed "Editorial Department."

Advertisements intended for insertion in next issue must be received not later than the 15th of the month (as much earlier as possible), to insure correct classification. All communications respecting same to be marked "Business Department." Advertising Rates, on application, regulated according to positions available.

Subscriptions and letters with reference to copies to be marked "Subscription Department."

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For Buyers' Guide, Index to Advertisers, and Directory of leading British Manufacturers, see page ii. of second cover, and pages iii. to xiii. (in first part of Magazine).

All communications to be addressed

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NOTE.—Owing to the exceptional demand for our first issue, and the consequent encroachment on our stock, we are compelled to raise the price from this date to 5/- for single copies. New subscribers, however, can include No. 1 in their subscriptions by remitting *Three Shillings* in addition to the ordinary subscription, which is 12/-.

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"To the Front!"

The Value of British Exports for the Nine Months ending September 30th, 1898, was £172,729,158 . . . The value of British Exports for the Nine Months ending September 30th, 1899, was £194,351,197, an increase for the Nine Months of £21,622,039 . . . Accounts relating to Trade and Navigation of the United Kingdom. Published by and on account of H.M. Stationery Office, October, 1899.

LONG ago it was recognised that the British nation, in any national exertion, only begins to put forth its real strength just at that moment when, to outside observers, it appears beginning to become exhausted. Our persistent habit of self-depreciation is responsible for the bewilderment which we have often been the means of occasioning in the minds of foreign critics. In spite of all that is said abroad to our disparagement, we are still our own most rigid censors—continually despising ourselves in public, and shouting our decadence to an incredulous world.

There is no questioning the fact of the existence of a steady belief that the industrial supremacy of Great Britain is declining. Great Britain itself has been the first to acclaim it, and the intimation has been joyously accepted, though, perhaps, with some secret misgivings, by a number of foreign rivals. Not only have our newspapers been devoting their space to interminable harangues relating to our industrial shortcomings, but a series of events, so related and connected as to deprive them of a mere casual nature, have afforded material presumption that the cry of alarm has been no unfounded one; that we, as an industrial nation, are indeed steadily losing ground and threatened with the prospect, unless we amend our ways, of receding from our proud solitary position in the front to become, perforce, the companion of others in the rear.

The alarm has been a natural one. We have been obliged to endure invasion after invasion into our industrial territory. American locomotives, American steam-engines, German and Swiss electrical plant, and Belgian girders, have visited our shores, and will, we are afraid, for a time, continue to do so. British manufacturing supremacy, in short, is now being subjected to a competition more formidable than in any previous period in its history. Every indication, save perhaps one, shows that the state of our manufactures does deserve the serious concern now being manifested with regard to it.

The mitigating circumstance to which we have referred consists in the recently published Board of Trade returns.

We find that the export trade of this country for the nine months ending the 30th of September last exceeded those of the nine months of the preceding year by a value represented by no less a sum than £21,622,039. That is to say:—While the expert values for the first nine months of 1898, were £172,729,158, those of the first nine months of 1899 were £194,351,197. With the exception of £4,302,188, classed as "raw materials," the whole of this immense sum represents exported British manufactures. The increase is simply prodigious, and is certainly entitled to serious consideration.

We have observed a tendency—a dangerous one as we think—to place a reliance on these figures which, we are afraid, will turn out fallacious. Despite the outcry which has been made, there is still an interior idea that we are by no means in so bad a position as we make out. It has even been stated that the orders for foreign plant and machinery, of which so much has been said, may have been the symptom, not of inertness on the part of British manufacturers, but of the exact reverse; that with the enormous pressure on their resources indicated by the figures we have quoted, some of the overflow, so to speak, of the high water of returning commerce must have inevitably gone to their rivals, simply through the inability of British manufacturers to utilise it themselves.

There is a certain amount of plausibility in this suggestion, but we do not think it is one capable of being substantiated. In the first place, we know of certainty that in some important phases of mechanical

production Great Britain is behind her competitors; in the second, we know also that the foreign exports of other producing nations, notably the United States and Germany, have advanced in even a greater ratio than our own; and, thirdly, we do *not* know how far it is likely the leap in British manufactures will be continued or even repeated—whether it is to be regarded as natural or abnormal, as a sudden jump to a position that will not be maintained.

It is necessary to point out that though the Board of Trade returns give the sum total increase of British exports as £21,622,039, that is not a correct comparative total. In this amount there figures a total of £6,289,732, representing the value of new ships built for foreign owners and not registered in previous accounts. Therefore, the nearest total we can reach to establish a legitimate basis of comparison is £15,332,307. That the advance represented by this sum is a definite criterion of the advance of British industry, is doubtful. That our manufacturers, in that silent unobtrusive way so characteristic of the British character, are working steadily in the maintenance and furtherance of our industrial supremacy is, as we believe, undoubted. We are not of those who pretend to level the aspersion of pig-headedness against the typical British manufacturer. On the contrary, we believe it to be the fact that the representative British employer presents a curious and interesting paradox in his character. He is at once the most conservative and the most revolutionary of men. Above all things, he is thorough. Given that he thinks a good thing, and he sticks to it with bulldog tenacity. But should he become thoroughly convinced that a change is necessary, he is ready to make a clean sweep and become a pioneer like his forefathers. Are our British manufacturers convinced that there are changes wanted in certain branches of British industry? We think they are; and if they are, we know what the result will be. British spirit, British determination, and British intellect, conjoined with the resources of the richest country the world has ever seen, will eventually conquer evanescent circumstances and permanently dominate a position we still retain and which we intend to hold to the end. Let each manufacturer, then, accept a watchword which the times render singularly appropriate, and, girding up his energies, devote himself with heart and soul to his task and echo in his mind the title of our article—"To the Front!"

Still more about Consular Reports.

BEFORE we proceed to further criticise their handiwork, let us first acknowledge the generous reception this Magazine has met with at the hands of the British Consular Service throughout the world.

Considering the attitude we have taken regarding the value to the country of at least a portion of their labours, we might reasonably have expected the awakening of some expressions of resentment in response to our strictures. But throughout the whole of the letters we have received, and these have reached us from all quarters of the globe, we have not traced one tinge of animus; nor, with the exception here and there of a few deprecatory remarks, any attempt to contradict or confute the statements we have made. On the contrary, the letters that have been almost daily reaching us have formed a constant iteration of praise and offers of service and general goodwill.

Under such circumstances, we find the pursuit of our duty a somewhat ungrateful task. But we are assured that the British Consular Service have far too high a sense of their responsibilities to oppose a reform which has become necessary in the interests of the country. We have never cast an aspersion on the service personally. In zeal and ability we believe them to be more than equal to any of their

compeers. It is the System only that we have attacked. A System that in the light of modern competition has become antiquated, and which, like other useless antiquities, must be swept away.

"I have read with much interest," says a correspondent, "your notes *re* our Reports. Before going further, I must warn you that if you want to get any opinion from a consul you must suppress his name. The Foreign Office do not like, and very rightly, journalistic consuls, or men whose names are constantly in the press.

"As to the Reports, I quite agree with you. But have you any idea how difficult these Reports are to prepare? Take this district, for instance: I have ——* vice-consuls; only one is professional, and I have to educate him after nearly ten years' service. Last year he omitted from his Report any mention of ——* industry, which exports some 2,000 bales yearly. His Report was a very long one, but I condensed it to one page of print. Next year I intend to remodel the whole thing. If I do not send in a Report, it appears as if I neglected my duty, whereas, as a fact, the statistics obtained officially are worthless, as no one declares his imports truthfully, because he would have to pay too much duty on them."

The above extract shows the writer of the communication from which it is taken to be a conscientious public servant, anxious to do his duty to the very best of his ability, which renders his total misapprehension of what is really required of him by the public the more touching.

It is so difficult to obtain correct "statistics," he says. Whence this unholy rage for statistics? What does it matter to the British merchant that the importation of salt-fish into Hakodate was 3,853 tons in 1897 and 4,436 tons in 1898?† Or whether the burials in the Protestant Cemetery in Rio Grande Do Sul in the year 1898 over the age of seven and under the age of seven were in number five and six respectively?*

Does the Foreign Office seriously consider information of this class to be of any material benefit to the public?

The Consul-General whose letter we have quoted confesses his statistics cannot be relied on, yet he continues to embody them in his Report, because, as he says, if he failed to do so it would appear as if he "neglected his duty"! This disclosure is one of some interest, as it arouses some natural speculation as to how many other Consuls abroad are in a similar position. Our point is, however, that even were the statistics correct they are, for the most part, of no commercial value; if incorrect—as appears likely to be the case—what can be said of them by even their supporters?

We now take this opportunity of offering our readers a comparison—an ineffective one, it is true, since our space does not permit us to do it justice—between a Consular Service that is not a mere mill for grinding out meaningless statistics, but a service that attempts, and with some effect, to be of value to its country. We have tried to the best of our ability to render the comparison a fair one. We have not sought out the strong points of the United States Service and the weak ones of the British Service to institute an unjust contrast. We have, so far as we have been able, incorporated the best on both sides, though we acknowledge presenting some of the grotesque characteristics of our own Blue Books in order to emphasize their absence in their rival. We invite our readers to look carefully through the *précis* on the following pages.

[NOTE.—It has not escaped our attention that since the publication of our first article on this subject, two months ago, some preparations have been made, apparently on the lines of our suggestion that the Consular Reports, so far as they related to commercial matters, should be placed under the control of the Board of Trade. We hope to be in a position to place some authoritative information on the subject before our readers in our next issue.]

* We omit the number and also the class of manufactures, as they might afford a clue for the identification of the writer.

† Consular Report 2,297, Annual Series.

* Consular Report 2,332, Annual Series.

British and American Consular Reports:

A Comparison.

BRITISH.

A Synopsis of British Diplomatic and Consular Reports for August, 1899. Nos. 2323 to 2344 (inclusive), "Annual Series." No. 509 Miscellaneous Series. In parts.

DIGEST OF CONTENTS.

Trade of Dar-al-Baiba and District for the Years 1897 and 1898.

This Report consists of 40 pages, of which 22½ are occupied with tables of statistics. There are some interesting general observations at the beginning respecting the main characteristics of trade in Morocco, but little or nothing of value to British manufacturers or exporters. For instance, we see in the index this heading, "Advice to Travellers," and accordingly look for some practical information as to the manner in which they should go about their business: the nature of goods in demand, prices, localities, etc. The following, however, is all that is comprised under this head.

> "All visitors to Morocco, commercial travellers and others, who bring their fowling-pieces with them, should leave them on board ship until they first communicate with their friends on shore, and find out how they can be safely landed. Any European bringing a gun ashore should on no account allow it out of his hands, and if any attempt is made to take it from him he should do his best to keep it within his grasp, sit down quietly, and request that his Consul should be communicated with. Instances have occurred when smooth-bores belonging to Europeans have been taken from native porters and quietly confiscated by the customs authorities."

With regard to the laboriously prepared tables of statistics, which may or may *not* be correct, we notice that some of the gross sectional totals in instances are as low as £3!

AMERICAN.

A Synopsis of United States Consular Reports for August, 1899. [Published in one volume, 200 pp.]

DIGEST OF CONTENTS.

Table of Contents.
Reports by Countries (Index).
Values of Foreign Coins and Currencies.

These tables are divided into three sections: "Countries with Fixed Currencies; Countries with Floating Currencies": with an addendum "Quarterly Valuations of Fluctuating Currencies." The values are expressed in United States gold and to three decimals.

Foreign Weights and Measures.

These are most exhaustive, and arranged for rapid reference under tabular headings viz.:—"Denominations," "Where Used," and "American Equivalents." The figures are worked out to three and four decimals. To denote the exhaustive character of the table, it may be mentioned that eight different numerical definitions are given of the measure *Fanga* alone. The foregoing form the introduction to this volume.

Special Taxation for Department Stores in Germany.*

This Report is more of a general informative nature than of the practical character usually associated with United States Consular reports. It was prepared by Mr. Frank H. Mason, Consul-General at Berlin. The circumstances under which it was prepared (see Footnote) are worthy of notice, and the attitude of the British Foreign Office under a similar request might be speculated on with edification.

Preparation of Vermouth in France and Italy.†

This Report comprises fourteen pages, and gives minute instructions with recipes heretofore supposed to be secret regarding the

* Report obtained at the request of a Washington Press Association to the Manager, of which advance proofs were sent.

† At the request of a Chicago correspondent, a Department Instruction was sent to Consular Offices in France and Italy for information in regard to the preparation of Vermouth.

BRITISH *(continued).*

Trade of Canton for the Year 1898.

Eleven pages: statistics 3 pages. Amid 6 pages of closely printed matter there is one small item of information which we append:—

> "A few months ago the question was put to me by a British subject if he had a right to open a piece-goods shop in the city and take his goods there from the steamer free of likin. I notified the applicant that he would be within his treaty rights, and informed the Viceroy that I had done so, warning the latter and the likin office that any attempt to interfere with the goods or their owner would be made the subject of a claim against the official concerned. The usual arguments and protests were of course forthcoming, but I closed the discussion by stating that I was acting under instructions, and I am glad to say that hitherto there has been no cause of complaint. I would like to strongly urge on British merchants that there is an excellent opening here for large miscellaneous stores on the lines of "Whiteley's" for the sale of all kinds of foreign goods. Clocks, lamps, musical boxes, mechanical toys, jewellery, &c., would find a ready sale among the many wealthy families here. A store of the kind kept by Messrs. Vrard and Co., in Shanghai, would, I feel convinced, bring large profits, and would be the means of introducing to the Chinese numberless articles unknown to them at present. Many kinds of tinned provisions would also find a sale. Difficulties might arise at first, but with capital and energy excellent results should eventually be obtained."

The major portion of the matter, however, does not even pretend to be of any commercial value.

Trade of Chinkiang for the Year 1898.

This consists of general information—mostly statistical. There is not one line in it, from cover to cover, of direct assistance to British export trade.

Finances of Italy for the Year 1899.

This Report is 30 pages, mainly statistical, as may be inferred from its title. It has no commercial value.

Trade and General Condition of British Central Africa Protectorate for the Year 1898-9.

This Report is at one time admirable

AMERICAN *(continued).*

preparation of vermouth. Cost, selling prices, and practical hints are given, and it is the evident purpose of the paper to afford sufficient information for any American manufacturer to embark on this industry forthwith.

Omnibus and Tram Service in Paris.*

A short and pithy account of Omnibus and Tram services in Paris, giving about everything to be said on the matter in a page and a quarter of type.

Slate Trade in France.†

Contains within short compass full information regarding uses of slate in France: Price, duties, carriage, etc. Consul is not sanguine that United States can compete, but says:—

> "It might be worth while to forward samples to F. Repossi, Commission, rue d'Amérique and Place Washington, Nice. This gentleman is working hard to create a direct importation of American products, under the surveillance of my vice-consul, and if sufficiently encouraged he intends to open a large sample room of American goods exclusively, with the object of developing a direct import trade from the United States by sea."

Free Zones in France.

One page regarding a proposed "Free Zone," at Marseilles and elsewhere, into which imports might be brought, manufactured or manipulated there, and then re-exported without payment of duty or incurring any restriction whatever; in fact, a sort of Free Trade area. The Consul gives a draft of the proposition to be submitted to the French Chamber.

Electric Traction in Marseilles: Windows and Doors in Marseilles.

The state of electric traction in Marseilles is considered, and also the possibilities of a United States export trade in ready-made doors and windows. A technical description of the type of doors and windows in general use is given, with their shapes and sizes, with prices. As no factory-made doors are sold no figures for these, it is stated, can be given. The report winds up:—

> "I have no suggestions to make as to packing for exportation. No doors are imported. There are no local exporters of doors. Among the most important local contractors are the following:

* Report in response to Chicago firm who had advance sheets.

† For a Pennsylvania firm who had advance sheets.

BRITISH *(continued).*

and—useless. It contains most exhaustive meteorological tables, and also the information that we are, as it seems, opening up the country more for the benefit of commercial rivals than our own. We are told in general, that German blankets are displacing English, being "cheaper and more showy"; but not the faintest information is vouchsafed as to the wants of the natives or the best means of satisfying them. Italy and Austria have the monopoly of the bead trade, we are told; but that is all. The impression is distinct in going over this as well as other British Consular reports that practical trade details are considered beneath the dignity of our officials abroad.

Trade of Chinde for the Year 1898.

Of no value.

Trade of Nicaragua for the Year 1898.

The ordinary general survey with six "annexes," consisting of tables of statistics. The following is a fair example of the information provided:

> "Most of the trade of the interior of Nicaragua is done through the Pacific ports of Corinto and San Juan del Sur. At least 50 per cent. of all imports come to Corinto, and this is really the most important port of the country, and affords greater facilities to merchants residing in the large central towns by the railway connection. Corinto harbour is considered a very good one, accommodating a large number of good-sized vessels; provisions can always be obtained, although rather dear; there is also now a constant supply of British coal, costing about 18 to 20 dol. gold (about £4) per ton put alongside the vessel, or 2 dol. (about 8*s.*) per ton cheaper than it can be obtained at Panama or Acapulco, where Chilian or Australian coal is generally provided. Loading facilities are about 200 tons per day. Port dues are 10 c. currency (about 2*d.*) per ton for ships in ballast and receiving cargo and 20 c. currency (about 4*d.*) per ton for vessels bringing cargo. There is no buoy now, the old one having sunk, but on an island at the entrance of harbour there is a good lighthouse 83 feet above the level of the sea, and the light can be seen from 12 to 15 miles. Annexes F and G show the shipping at this port for the past year."

AMERICAN *(continued).*

> L. Gassier de Bastide, rue Consolat, 63.
> H. Beranger, rue Clothilde, 36.
> Jauffret Frères, rue de la Rotonde, 23.
> Andre Capel, rue Consolat, 138.
>
> The questions relating to sashes are nearly all answered by the foregoing."

Commercial Travellers in France and Paris.

A series of valuable hints to American commercial travellers and particulars of railway "cartes de circulation," with prices.

Trades Combination in Great Britain.

A very intelligent review of the scheme originated by Mr. G. J. Smith, author of the Bedstead Manufacturers' Association.

Notes and Suggestions for Trade in Scotland.

It will suffice for us to make a few extracts from this Report as follows:—

After recommending a display of motor cars at the forthcoming Glasgow Exhibition, the Consul addresses himself to the subject of American exported boots and shoes. He says these are obtaining good prices, boots for ladies selling at about 19*s.*, and shoes at about 12*s.* per pair. They are in high favour, owing to their elegant finish and appearance. He points out at the same time that the sole leather, owing to the dampness and wet weather prevalent in Scotland, is often not quite up to the mark, and suggests the defect be amended. He opines there is a great opening for printing and binding machinery in Edinburgh. He expresses himself in the following terms:—

> "American machinery has become an important factor in the printing and bookbinding trades in Edinburgh. Six large printing establishments have twelve American presses, an average of two each, for book and magazine work. The oldest and most famous house in the city has three. Other printing houses, doing general work, have also introduced American presses. Some of the book and magazine printers have, in addition to the presses, American folding machines, stitching machines, case-making (book-cover) machines, and backing machines. The leading printers express a very favourable opinion of all these classes of American machinery, and, notwithstanding the prices are at present comparatively high, the demand is likely to increase. This means much to American manufacturers in these lines, for, barring London, Edinburgh is the chief centre of the printing industry in the United Kingdom. I have heard only one criticism—if I may use this term—of the presses and

BRITISH *(continued)*.

Trade of Naples and District for the Year 1898 (Supplementary).

This report commences in this way:—"At the close of the last century the Bourbon King Charles III. built the noble palace of Caserta about 18 miles from Naples, and it was then that a French geologist discovered the marble quarries of Vitulano," &c. There is a dissertation on the growing practice of drinking tea, a description of the new Bourse with historical details, and a description of the process of making fishing gut. There is a reference to drainage systems and statistics (of course) respecting the percentage of deaths from tuberculosis. "Pane's Serum," "Cotton Goods," "Steven's Collection of Antiquities," "The Pro Napoli Association," and the "Suppression of Begging," are headings which follow in order; the balance is mostly statistics. There are 33 pages.

Trade of Sicily for the Year 1898.

This is of the general order, but the author, Mr. Churchill, appears to have some genuine solicitude for the practical advancement of British export trade. He says:—

> "Many enquiries have been passed on to manufactories for price lists, besides various enquiries made through the Foreign Office or the different Chambers of Commerce. In many instances no replies have been received, or when they have been received, it has been weeks after the enquiry was first made, and after others have been applied to. In some cases where small initial orders were in question, the Consulate has sent the orders in the hope that once the goods were tried the opening might lead to a permanency of relations between the parties concerned. No pains have been spared to encourage local merchants and dealers to take up British goods. In cases where there is any doubt as to the credit of those ordering goods, it is always possible to send the bills of lading to some responsible person to hold until payment is made. The Consulate is always ready to answer questions under this head."

The statistical tables, of which there are so many, must have involved an immense

AMERICAN *(continued)*.

> that is that their maximum speed is greater than necessary. The backing and cover-making machines give entire satisfaction. The American stitches introduced are as yet used only in binding the best class of books. The cheaper books, which are coarsely stitched, are sewn on German stitchers."

The Consul states he has ascertained there is an opening for American Portland Cement, and states he has furnished the names of several leading American manufacturers to enquirers. He winds up by the statement that although the quantity of meat seized during the current year in Edinburgh was 149,163 lbs., not a single pound of American chilled meat was condemned, although the consumption of it in Edinburgh per week, (excluding Leith) was 31,500 lbs.

Southampton Cold Storage Company.

Consul mentions proposed enlargement of cold-storage accommodation, with view of U.S. increasing exports.

Belgian Trade with the United States in 1897.

Consists simply of a table of statistics of Imports from the U.S. into Belgium.

Waterworks in Russian Cities.

The Consul sends specifications of proposed waterworks in the city of Nicolaiev, Russia. He says:—

> "My object in sending the details as given in the inclosed translation is to bring to the notice of American firms the entire project, so that they can bid on the entire contract or can arrange to supply water pipe, pumps, and other machinery. Bids will be received within the next six months."

Railways in Switzerland.*

This appears a most valuable report, and must have entailed an immense amount of work, which, however, occupies a very small compass. It consists almost entirely of a tabulated statement of railways in existence, and in course of erection and contemplation in Switzerland. It is pointed out, that in proportion to its area, no country equals Switzerland in the number of railways in actual use and projected, or in the diversified applications of motive powers. The matter occupies nearly nine closely printed pages; we give specimen lines:—

* Written in reply to requests by railway builders n Chicago, New York, and Philadelphia, who were sent advance sheets.

BRITISH *(continued)*.

amount of the most laborious work and their practical value—or that at least of the large proportion of them—is *nil*.

Trade of Rio Grande Do Sul and District for the Year 1898.

This Report (pp. 26) contains a coloured chart, as to the value of which we express no opinion, setting forth "The Average Monthly Depth of the Soundings on the Rio Grande Do Sul Bar from 1896 to 1898 inclusive." There are a large number of statistical tables, one of the most voluminous stating the "Principal Causes of Death during the Year 1898," whilst a supplementary table gives "Burials in Protestant Cemetery," "Over Seven Years," and "Under Seven Years," which it appears amounted to five and six respectively. It must, however, be said to the credit of the Consul that he has had the enterprise to undertake the very daring and unusual step expressed in the following :—

> "Native prints are now being made, and though it is difficult yet to form a definite opinion as to how far they will eventually supplant the imported article, they are sold at prices much under those at which, in present circumstances, foreign prints can be sold. Two quality samples, Nos. 1 and 2, and five designs, Nos. 1 to 5, accompany this report. The designs are very simple and of a low cost in England, but the cloth is very good, and too heavy for anything imported to compete with it in price after paying the duty now in force. These goods serve for such people as make cheapness the principal consideration, more especially as they are durable, but the majority prefer to pay more for a good design even on an inferior cloth."

Particulars are given of two cycling clubs, with statistics of the cycles they use. It appears from the table that the "Adler" takes first position by 47 out of 99. Of English make there are two.

Trade of Madeira for the Year 1898.

Calls for no observation, excepting in the

AMERICAN *(continued)*.

Railways in Actual Use.

Name of road.	Address.	Opening of first part.	Length.	System used.
Main steam truck lines.			*Kilom.**	
Schweizerische Nordostbahn.	Zurich	Aug. 9,1847	723	Locomotive.

Railways Projected and in course of Construction.

Name of line.	Holders of concession.	Date of concession.	Projected length.	Cogwheel.	Cable.	Tramway.	System used.
Aarau-Menziken	Dr. Du Riche-Preller, Ingénieur, Zurich u. Kons.	July and, 1897.	22.1	.....	.....	.....	Electric.

* 1 kilometer = 0·62137 mile.

Under the latter heading there are some 130 entries, the concessions in September last year amounting to a total of 2,030 kilometres (1,263 miles). Personal visits from American contractors are recommended.

Trade in Prague.

The method in which the British Consul would deal with the question embraced by the above title is easily imagined. He would transmit table after table of minute statistics of no earthly use to anybody. This Report contains *not a single table*. The Consul merely says : The export from this district for the quarter ending March, 1898, slightly exceeded the export for the same quarter in 1899, the values being $352,535 and $331,027·85 respectively. He, however, wants agents from the United States to come over, both with respect to electrical supplies and slate. He says :—

> "The slate used is in the form of rectangles and hexagons, the sizes being from 12 by 6 to 21 by 11 inches, and so far the demand has been principally supplied from England, some also coming from France, Germany, and Switzerland. The last two countries send school slates as well. The first four carloads of American slate were brought here a few days ago through the firm of Josef Umlanft & Co., in Bodenbach, Bohemia. So far as this market is concerned, our exporters have shown

BRITISH *(continued)*.

statistics; it appears to us that a certain formula might embody the ordinary "Trade Report," to be used unchanged year by year.

Trade of Madagascar for the Year 1898.

British trade practically crushed through protective tariff imposed by French Government in 1897; therefore, no details.

Trade of Dantzic and District for the Year 1898.

Almost wholly statistical. The following item, however, is to be noted. It will be observed that the Consul has apparently not thought it worth his while to give the *name* of the company, nor any *address* to which enquiries might be sent :—

> "Whilst writing this report I see it announced that a company has purchased 82 acres of ground on the right bank of the river between Dantzig and the sea for the purpose of erecting steel foundry and rolling mills of the latest type. This commencement of industrial enterprise on a large scale in the North-east of Germany is hailed with joy by the local press. The new undertaking is to have an initial capital of £150,000, with power to increase it as required. It is likely that the shares will all be taken all up."

Trade of Mexico for the Year 1898.

The tendency that prevails in the preparation of Trade Consular Reports is very well expressed in the introduction of the above named. The Consul says :—

> "In the preparation of this report the object has been to give as much information as possible in a general way, but more especially in those articles in which British manufacturers are interested, and in view of the many enquiries received recently from Chambers of Commerce and business firms in Great Britain. Most of the figures in this report have been obtained from the Government returns, which have already been published, but owing to the courtesy of the Department of Statistics in furnishing data not yet published in detail,

AMERICAN *(continued)*.

> a certain apathy, possibly the result of the immense development of our exports during the last two years. This very extension of our trade will cause increased activity on the part of foreign manufacturers, and our exporters should cover every field possible and establish themselves firmly.

Foreign and Home Consumption of German Beer.

German Industrial Advance.

Here are eleven lines of statistics.

Consumption of Beet Sugar in Germany.

Nineteen lines of statistics.

American Shoes in Germany.

This Report is the essence of practical sense.

Shoe Trade in France.

We wish we could print this Report in full. It is a perfect model of what a trade Consular Report ought to be. The Consul gives a short description of French idiosyncrasies regarding their foot-gear, gives ruling prices, cost of importing U.S. goods, hints on style and finishes :—

> "I am not able to give a detailed description of the best-selling shoe in this market which would convey a correct idea of how the shoe is made, the kind of leather used, the style and shape, &c. But I am quite willing to purchase a pair of shoes which, in my judgment, should be a fair sample of the line of goods with which our manufacturers would have to compete and submit it to them."

There are similar reports on shoes from Rheims, Nice, Columbia, Ecuador, British Guiana, and China.

Germany in China.

Mica Field in China.

Consul transmits samples of mica, with cost price, with the idea of opening up mica mines by U.S. capitalists.

Collection of Debts in Japan.

Short paper, giving law procedure.

Japanese Civil-Service Regulations.

New Laws in Japan.

Japan's Commercial Museum.

Copper and Brass in Japan.

Above are doubtless inspired by abolition of Consular Courts in Japan.

Cultivation of Tobacco in Philippines.

Pearl Fisheries in Dutch East India.

Castor-Oil Plant in India.

Prizes for Hemp Machinery in New Zealand.

Consul says :—

> "Referring to my previous report on hemp-

BRITISH *(continued).*

the tables have been made more complete than they otherwise would have been."

Statistics are the last thing British manufacturers want to be bothered with. They want *information*, practical, precise, and to the point; and that is exactly what they do not get. This Report consists of an infinity of comparative figures, tables, and statistical details of all sorts. There are, it is true, some general recommendations addressed vaguely to British manufacturers, advising them to do this and that, but as to any practical assistance in doing so, not the ghost of a hint.

Trade of Gothenburg and District for the Year 1899.

Practically all statistics.

Trade of Port Said and Suez for the Year 1899.

Statistics. One informatory paragraph at end respecting proposed construction of three iron tanks. No particulars given.

Trade of North Formosa for the Year 1898.

Trade of Wuhu for the Year 1898.

Trade of Taman for the Year 1898.

Above call for no remark.

Trade of Riga and District for the Year 1898.

In this Report, which is of the usual statistical nature, we notice in the index this imposing heading. "*German Competition with Great Britain in Machinery, &c. Suggestions for Meeting it.*" We turn with interest to the page denoted and find—this!:—

"In some of the articles enumerated Great Britain has no competitor, but in others Germany runs her very close. In machinery for instance, the largest item in the returns, Germany is found to be competing very keenly in nearly every branch, and she has the advantage very often simply in consequence

AMERICAN *(continued).*

working machinery in New Zealand, published in *Consular Reports*, No. 225 (June, 1899), p. 332, I have to say that the last mail from the United States inundated this consulate with letters from all parts of our country, inquiring for further information on the subject. It being an impossiblity to answer each individual letter, I suggest the advisability of publishing, as fully as possible, in the American press, the annexed "official notice" recently gazetted by the Minister for Agriculture, Wellington, in order that American inventors may be afforded an opportunity to cope with inventors of other countries in perfecting a machine or process which will successfully treat the native flax of New Zealand."

Agriculture and Live Stock in N.S. Wales.

Wheat and Corn and Canned Meats in S. Africa.

American Manufacturers in S. African Republic.*

Consul discourses on selling prices of pianos, and styles most on demand; harness and saddlery and patent medicines also receive attention.

The Bicycle Trade in Canada.

Mining and Trade in British Columbia.

Salient figures are given of different districts and different manufactures, exports, and imports, *gross totals only.*

Mineral Production of British Columbia.

Gold-Mining in Alaska.

Trade Openings in British Columbia.

Consul writing from Vancouver gives a detailed list of manufactures in demand, embracing altogether seventeen, and suggests following, which should attract the attention of British exporters. The establishment of a kind of exhibitive store for samples in Vancouver, with two or three travelling salesmen, to visit various districts, "introducing the articles, quoting prices, soliciting orders, and giving information relative to the tariff duties, weights," etc.:—

"Such an establishment," says the Consul, "could be maintained at a cost which would fall very lightly on each contributor if a considerable number of persons or firms united in the enterprise," and adds that he should be glad to receive enquiries from interested persons on the subject of the article, and would esteem it "a pleasure as well as a duty to aid anyone in regard to the matter."

Irrigation in Mexico.

Port Dues in Mexico.

Dealing with excessive charges of steamship lines.

* Reply to Director Philadelphia Commercial Museum.

BRITISH *(continued)*.

of her characteristic persistence in placing her goods. If, however, more British capital was invested in the various industries in this country, there would naturally be greater interest brought to bear in favour of the importation of British goods, whether they consisted of raw materials, half manufactured goods, machinery, or tools."

The learned author, after this safe pronouncement, proceeds to deal with statistics concerning the importation of Scotch and Swedish herrings.

Trade of Russia for the Year 1898.

This Blue Book consists of 90 pages. As nearly as possible, half the number are occupied with tables of statistics. There does not seem the slightest attempt to assist the British exporter.

Trade of Germany for the Year 1898.

This Report begins :—

"As in previous years, I beg to introduce this Report of the trade of the year 1898 with a statistical statement of the import and export of the principal articles of trade between the United Kingdom and Germany."

This statement correctly represents the character of the book, which contains 44 pages.

British Trade with Switzerland for the Year 1899.

Worthy of no particular remark.

AMERICAN *(continued)*.

Railway Construction in Mexico.

Railway Contract in Venezuela.

Contains particulars (early) of railway between Puerto Cabello and Yaritagua.

Railways of Uruguay.

Deals largely with railway supplies, a considerable proportion of which come from Great Britain. Quotes existing prices and transport particulars for benefit of U.S. competitors; a very exhaustive Report, though, as usual, compressed to the utmost.

Light Railways in Argentina.

Proposed Railway in Peru.

Conditions for tender for railway from Oroya to Cerro de Pasco—about 60 miles.

Peruvian Trade and the United States Tariff.

Economic Progress of Uruguay.

Exports and Exporters of Puerto Cabello.

Copper and Brass in Jamaica.

Consul gives names of two importing firms in Kingston for U.S. exporters to apply to.

Cotton Goods in Hayti.

A lengthy Report, containing information to enable U.S. manufacturers to displace remainder of British cotton trade in the Republic. All prices are given.

Notes.

About fourteen pages of short notes on various subjects, each with bold heading.

Foreign Reports and Publications.

Comprising six pages, containing extracts, from British Consular Reports, etc. Latter occupies *one page* on *one* subject.

Index.

This covers 26 pages of small type, and appears to embrace every subject, name, and reference published.

SUMMARY.

British Consular Reports: August, 1899.

Total Number of Pages	627
Proportion of Tables of Statistics (matter)	189
Total percentage of Statistical Tables ..	30.1

United States Consular Reports: August, 1899.

Total Number of Pages	167
Proportion of Statistical Matter	11
Percentage of Statistical Matter	6.5

NOTE.—*It is to be observed that a large proportion of British Consular matter is composed of reference to statistics published.*

"We are, in the vastness of our possessions, losing our grip on national sentiment. It is our duty to maintain intact, and to defend by sea and land, all that our empire builders have left us. The day that sees the defence of the British Empire sapped, sees the disintegration of the Nation's trade and the hands of civilization's timepiece put back 200 years."—RT. HON. LORD CHARLES BERESFORD, C.B.

A New Development of the Power Loom.

IT is a curious yet a generally acknowledged fact, that a very large proportion of the more striking improvements which arise in machinery and processes come from inventors who have little or, in some cases, no practical experience of them. We have instance after instance of this. Whilst the inventors actively concerned in a manufacture are laboriously improving details of mechanisms, some outsider steps in with so revolutionary a change in their very principle that a whole industry is thrown out of gear.

This has been notably the fact of late, when the application of theory to practice in the form of applied science has caused such astonishing results. Mitscherlich, a German professor, practically revolutionised the paper industry; and Dr. Auer, another German scientist, inaugurated a new era in gas lighting and probably saved it from the partial extinction which threatened it at the hands of the electric incandescent light. Numerous other examples might be quoted, but they are too familiar to require repetition. The explanation, after all, is a very simple and natural one. An outside inventor has not his views cramped through constant association with his subject. He has no pre-conceived ideas, but takes a broad view. For the supreme control of the British Navy the British Government always selects, not an experienced admiral but a civilian who may never even have set his foot on a seagoing vessel. The policy has been proved to be a sound one, and it is closely related in its effects to the theory we have touched on. It is very seldom, indeed, that the inventor in a local sense, as applied to his practical association with the machinery he endeavours to improve, achieves any alteration in principle. His attention is fastened on subsidiaries and he lets the main organism alone. The non-local inventor, on the other hand, without any prepossessions whatever, does not occupy himself with the means but with the end. His object is to effect a certain object in the most efficient way, and he approaches the subject from a totally unbiassed standpoint. Thus it is that often he is able to sweep away at one stroke a mass of encumbering detail, fancied improvements that have clustered round a main principle during years of so-called development, and, as we have said, revolutionise an industry.

These considerations are, perhaps, more aptly expressed in the striking article from the pen of Professor Robert Beaumont, which appears in another part of the Magazine. Professor Beaumont says:—

"In all mechanical work and industrial operations it is questionable whether those in the know are the most likely or competent to initiate a new idea or strike a new vein. They, perhaps unconsciously, become conservative in their views as to the possibilities of new methods, for they have been familiar with the growth of an old form of mechanism which has been made increasingly useful and effective by improvement after improvement. It may be they have seen a certain machine in its undeveloped and unperfected state, and had to superintend its action during the process of metamorphosis which has transformed it into a wonderful and perfect invention in their eyes. No doubt here are some of the causes which retard the adoption of revolutionary doctrines mechanism for industrial purposes."

This theorem is exemplified by the Poyser loom, described by Professor Robert Beaumont elsewhere. The construction of this loom is one of the most daring originality. As Professor Robert Beaumont says :—

"No expert would have been daring enough to have attempted placing the shuttle containing the weft yarn behind the sley or reed, and of dividing the latter in two for the insertion of each pick of weft which is one of the leading and distinctive features of the Poyser loom, and of itself sufficient to merit its being defined as 'a revolutionary invention in weaving.'"

The history of the invention is an interesting one, but we cannot do better than refer our readers to the pages elsewhere in which it is recorded.

Aluminium Coinage . . .

WE notice that the British Aluminium Company, Limited, have addressed the Government of India, to suggest that aluminium slightly alloyed should be used in the manufacture of coinage to replace the present copper or bronze coinage in India. This idea is, of course, owing to the fact that in consequence of the great demand for copper for electrical conductors the value of the metal has advanced intermittently during the past few years, and appears likely to continue to do so. Therefore, it is not by any means improbable that an alternative metal to copper for coinage will become a necessity in the near future, when, as seems probable, the market price of copper has increased beyond its coinage-face value.

Yet, in spite of this fact, we hesitate to place much reliance upon aluminium for the purpose which the British Aluminium Co. have designated. Aluminium as an industrial metal has been very disappointing. Its undeniable merits, strength and lightness, are discounted to a serious extent by defects which it does not appear possible to overcome, so far as present experience enables us to judge. However brilliantly polished in the first instance, it oxidises very rapidly and assumes a shabby appearance in ordinary use. For maritime purposes, in connection with which the highest expectations were at first entertained, it has been proved to be simply impossible, in consequence of the electrolytic effects which follow its immergence in sea water. It is practically impossi le to obtain a lasting solder with aluminium, and all aluminium utensils and most other objects have to be stamped or drawn. And with regard to coinage, it must be remembered that the United States Government made most exhaustive experiments with aluminium and alloyed aluminium a few years ago, but did not find these experiments at all so encouraging as to entitle them to even a tentative practice.

The War in South Africa . . .

No references, other than those of the most general character, concerning the deplorable struggle now existing in South Africa come within the scope of this magazine. Yet we cannot allow an issue to pass without reference to an event fraught with such far-reaching consequences to the future of the British Empire.

The result of the war is pre-determined, even in the opinion of our opponents. Why they should resolve to fight hopelessly to an issue which they themselves recognise as inevitable is a question that forms only one of those sinister problems which from the first dawn of human intelligence have continued to assail mankind. Dismissing such considerations, however, and anticipating the certain result—the sooner the better—of this present war, we see no reason to anticipate other than the most beneficial results issuing from the assured triumph of British arms. We are not disposed to indulge in any political rhapsodies concerning "festering sores," "founts of treason," and so forth; but what we do look forward to with feelings of genuine hope and pleasure is the extension of British trade from Cape Town to the Zambesi, with equal rights to all. The absorption of the Free State and Transvaal into the British Empire, which is now certain, cannot be other than productive of good, both to the citizens of the hitherto alien territories and the world at large.

The Utilisation of Natural Water Powers in India. . . .

THE intelligence that the utilisation of certain natural water powers in India is under consideration gives rise to some interesting speculations. The conversion of waterfalls into sources of power, since the historic success achieved at Niagara, has proceeded with an accumulated vigour, and promises before long to introduce a new feature into industrial economy. We are informed now that three extensive schemes of this kind are being considered in India, viz., the utilisation of a fall in Cashmere, that of the great Silva Tamundrum Falls on the Cauvery, and the Nerbudda Falls near Jubbulpore. The power, of course, will be exerted by turbines to operate electric generators, the resulting electric current being used for the electric furnace and to drive motors.

Up to the present, electricity generated by natural water-power has been chiefly utilised for several special industries, notably the production of what are called electro-chemical products—especially aluminium and carbide of calcium. There is no reason to suppose, however, that in such a country as India, with its teeming native population, water power could not take the place of coal to a material degree for industrial uses apart from those for which it has been hitherto chiefly employed. At the same time it is probable that for a considerable period to come these remote sources of power when employed will be devoted to electro-chemical purposes, and the day will possibly come when we shall see India endowed with a manufacturing and perhaps an export trade in Caustic Soda, Chloride of Lime, Sodium, Aluminium and Calcic Carbide. In the northern regions of India especially many valuable sources of motive power lie neglected, requiring only the plant and the simplest of raw materials to render them fruitful centres of industrial activity.

It appears to be an unfortunate, but at the same time an undoubted, fact that the special type of electric plant required for the production of both aluminium and carbide of calcium cannot be obtained in this country. The statement may be disputed, but in that case how can the circumstances be accounted for that the two firms which claim respectively a monopoly of the manufacture of aluminium and carbide of calcium in this country, the British Aluminium Co. and the Acetylene Illuminating Co., with the best of dispositions in favour of British manufacturers, have been obliged to go to Switzerland, not only for their original plant, but for the extensions that have since been made?

When these natural powers in India are developed, therefore, as there is little doubt they speedily will be, will it be still obligatory on the projectors of the enterprises associated with them to pass by British electrical engineers in favour of Swiss or German?

Impact Tests of Steel. . . .

AMONGST other properties of iron and steel, that of resistance to impact has hardly received the attention which its importance merits. A great deal is heard of tensile strength, and in the minds of many persons the impression exists that this is the chief essential quality. Experienced engineers do not share this opinion, for they have found that power of resistance to sudden shock is of even more value than capacity for withstanding tensile stress. At the same time, however, it should be said that accepted methods of measuring shock resistance are by no means satisfactory, and the appliances used are seldom constructed conformably with the dictates of modern experimental science. An improved machine designed for tensile and transverse impact tests, has already been described and illustrated in the "Transactions of the American Society of Civil Engineers," and the announcement is now made that some ascertained results will be laid before and discussed by the Society at an early date. The machine in question differs very much from those of the ordinarily used kind, in which impact is occasioned by a weight falling upon a test bar supported at each end. In the new machine, as arranged

for tensile impact tests, the blow falls not against the specimen but on a rigid bar to which one end of the test piece is secured, its other extremity being attached to a rigid block. In place of the usual falling weight, a pendulum pivoted on a horizontal axis is employed. There are provided attachments for reading the distance through which the centre of gravity of the pendulum falls and for registering the height to which it rises after the blow. The difference between these measurements, when considered in connection with weight, affords an index to the energy absorbed in breaking the specimen. In order that the pendulum may have a free course after impact, the bar to which one end of the test piece was fixed swings aside. For transverse tests two fixed supports are used, and after fracture of the specimen the pendulum swings past as before. In tests of either kind breakage is invariably effected by a single blow, and allowances are made for friction and for absorption of energy other than that expended in the desired direction. Observations hitherto published show that results depend largely on form, but it is also clearly established not only that shock resistance of steel bears no definite relation to tensile strength and elongation, but, further, that it exhibits extreme variations in specimens of uniform tensile strength. Assuming the establishment of the latter conclusions, it becomes evident that the faith now so largely reposed on tensile and similar tests is in many instances entirely misplaced. Further, the results mentioned suggest a possible solution of recent unexplained failures of steel whose quality was judged by ordinary methods to be beyond question.

We anticipate further information from the coming discussion of the subject by the American Society; but in the meantime sufficient indication is forthcoming that what we may term impactile strength will, in all probability, shortly acquire a determinate character and a new importance.

NOTE.—Mr. HIRAM S. MAXIM and Mr. GEORGE A. GOODWIN, M.I.C.E., are contributing remarkable articles on "CHINA" in our next number.

Heavy Road Traction. . . .

THE automobile industry, which has been growing and flourishing on the Continent, had its real origin in England. Steam carriages to run on ordinary roads were in practical operation in this country at the time when steam locomotion on rails was regarded as no more than a doubtful experiment. A regular passenger service, indeed, between London and Stratford, served by a steam omnibus, attained such a vogue that it was regarded as a permanent institution. "Hancock's" steam carriage was in every respect a thoroughly practical vehicle. But it, and others like it, were thrown off the roads through the indiscriminatory craze created by the success of railway locomotion. Restrictive legislation, together with the prepossession that no natural road traffic could possibly compete with rails, choked a new and promising industry. It has slumbered all these years, only now to be awakened into renewed activity.

In Mr. Thornycroft's paper on "Some Recent Experiments with Steam Vehicles," which we present in this issue, we find that the author began his researches nearly forty years ago into what was at that time a decayed industry. He designed a number of steam-propelled vehicles; but, under the circumstances, it is not difficult to understand that his efforts came to no practical issue. He appears to have diverted his attention, probably in consequence of the deterring circumstances then prevailing, to the development of high-speed marine vessels, in which he has achieved so brilliant a success.

However, with the advent of the Locomotives on Highways Act of 1896, Mr. Thornycroft turned to the subject of his earlier labours. His renewed efforts in this direction have already afforded results that appear likely to invest their author with a degree of distinction equal to that he has legitimately attained as a pioneer in rapid mechanically propelled water vessels. The recent trials at Liverpool and elsewhere have demonstrated the fact that the Thornycroft motor carriages are just as good in their way as

his far-famed launches and torpedo boats, and there can be no doubt that under normal conditions they will achieve an analogous position.

But, as Mr. Thornycroft points out, recent legislation, though mitigating largely the oppressive character of the locomotive laws, is not yet by any means complete. He suggests an amendment to it, and we hope that it will be brought in due course before the attention of the legislature. We repeat Mr. Thornycroft's suggestion here, as it is one which, in our opinion, is most reasonable in its nature, and one that if adopted—which it surely will be—cannot be followed by any inimical results. It is this:—

> *I suggest that the existing law be amended as follows:—In lieu of the present tare limit of 3 tons, a maximum load per inch-width of tyre be decreed; such load to be decided upon from an induction of cases of existing heavy load horse-drawn vehicles. It can hardly be contended that this is other than a fair and reasonable suggestion; should it be objected to, however, one may recommend that the tare for 5-ton loads carried on one vehicle be raised to 4½ tons; if carried on two vehicles, to 5½ tons.*

We are glad to see that, due largely to Mr. Thornycroft's initiative, the Automobile Club of Great Britain is taking the matter up in earnest, and an organised and influential representation will shortly be made, urging the appeal or alteration of the objectionable clause in the Acts in question.

Latter-day Telegraphy . . .

Accounts of new and improved applications of electricity are frequent in these days when so much attention is being devoted to investigation by practical scientific men. It is not advisable to accept with simple faith all promised wonders, nor, on the other hand, is it wise to be consistently sceptical.

Etheric telegraphy, which is generally, but not happily, named wireless telegraphy, is by no means new in theory, though it may be in practice. In the popular imagination this system is probably overrated as much as it is underrated in some technical journals. One of our contemporaries has only lately delivered itself of an article where difficulties are recited in cheerlessly agnostic tones, which we are by no means disposed to re-echo.

It cannot be denied that before etheric telegraphy can replace the ordinary system there are several problems to be solved. Hopeful progress has, however, been made, and during the meeting of the British Association messages were not only exchanged between Dover and places on the French coast, but some indications of these were noticed at Chelmsford by Marconi's assistants when engaged in fitting apparatus for communicating with Harwich. The occurrence suggested to the operators the trial of a message to Wimereaux, in France, where it was known a receiving instrument had been placed. This experiment being rewarded with success, it becomes clear that distances of fully ninety miles may be traversed without difficulty. Thus one of the hypothetical objections made by despondent critics some time ago is finally negatived. Of course, the chief desire is now to discover the manner in which the direction of etheric telegrams may be absolutely controlled. Until this is done no messages of a confidential nature can conveniently be sent. Rumours have from time to time been current as to the accomplishment of this end, and now we have tidings of a patent covering a method believed by the inventors to be capable of directing messages to one station and to no others. Whether this hope will be realised it is too early to say, but eventually success is morally certain. In the meantime there are many uses to which etheric telegraphy may be put. The French Government has already established communication between the Ushant coast and lightships at distances of thirty-five miles apart, and other installations of kindred nature are to follow. In naval operations the new mode of telegraphy will provide an invaluable means of intercommunication between vessels of a fleet, and also with bases on an adjacent shore. On land,

military commanders will be provided with a mobile system of despatching orders and of receiving reports. The general public will, however, have to wait for further developments before their turn comes. Leaving out of consideration sensational reports of electrical wonders, emanating from publications intended to tickle the public ear rather than to relate hard scientific facts, we will proceed to mention the Polak-Virag method of transmission lately investigated at Buda-Pesth and Vienna. At first sight it does not seem evident that any novelty is presented by the appliance in question, which in its general construction very much resembles the Wheatstone automatic apparatus. The chief feature worthy of attention is the rapidity with which messages are said to be sent, and the speed recorded considerably exceeds that attainable hitherto. It is very likely that the trials were conducted under favourable circumstances, and British electricians will be more satisfied when opportunities have been afforded for tests of a comparative nature, where the Wheatstone and Delany apparatus may also be tried under exactly similar conditions. At present we know that high speeds are difficult of attainment when length exceeds certain limits, but it is also probable that special transmitting and receiving apparatus may in some measure qualify this difficulty. In the recent trials, messages of 200 words between Buda-Pesth and Berlin were sent and received within the space of nine seconds, and we are promised that as many as 100,000 words per hour may be transmitted. Further experience of this invention will be decidedly interesting, and, we hope, advantageous.

The Advance in Gas Manufacture. . .

THE art of manufacturing gas has advanced considerably since the period when "inflammable air," or "inflammable smoke," as it was indifferently termed, first came before the public notice. If the experimenter—who, first filling a bladder with the "inflammable smoke," connected the bladder with a piece of iron pipe, and displayed the result of ignition to a circle of admiring friends—had been able to take a prophetic glimpse, so to speak, at the development of his experiment as it exists at the present day, he would, in all probability, have been considerably astonished.

But for some years such demonstrations were looked on as no more than curious phenomena in natural philosophy, and no suspicion of any industrial value to be attached to them seems to have occurred to the minds of their innocent projectors.

It is, indeed, rather astonishing how many years have been required to bring the manufacture of gas to its present state. The sulphurous compounds that used to be issued from the gas manufactories are still familiar in the remembrance of most living people. Nor was it until many years had passed that how rich a vein of wealth, so long neglected, was discovered to exist in the despised bye-products of gas works. Like the tailings of a rich gold mine before the advent of chlorination they were regarded as a nuisance, and the pestiferous refuse entailed by the generation of gas was considered a serious drawback to its manufacture.

The enormous difference between the gas-making of fifty years ago and that of the present day will be realised by a perusal of the articles from the pen of Mr. G. E. Stevenson, the first of which appears in the present issue. Not only has the development of automatic appliances vastly increased the working economy of the modern gas manufactory, but rendered the state of the present-day gas stoker almost a paradise in comparison with the circumstances he was formerly compelled to endure. As an exponent of up-to-date practice Mr. Stevenson has no superior, and we have no doubt his articles will be of value, as well as interest, to our readers.

FEILDEN'S MAGAZINE has averaged a circulation of

10,000 COPIES

per issue. The demand for the present issue has necessitated an edition of nearly

11,000.

A Second Edition of every number has had to be printed.

Notes.

A CORRESPONDENT has written to say that he is afraid we are in danger of injuring the susceptibilities of foreign nations by insisting so resolutely on carrying out our "militantly" British policy. As to this, we have to say that under present circumstances it is becoming increasingly necessary for some strong organ to keep our manufacturers alive to the danger which is threatening the commercial supremacy of our country: that is where we are "militant." Our policy is not one of militant pugnacity, but a watchfulness and assertiveness of British manufactured products. The United Kingdom is the greatest industrial nation on earth, but she cannot expect to dominate the world's trade for ever. We can at least, however, do our best to keep in the front ranks, and our policy has simply that for its aim. In this we look for the sympathy and support of every firm in the country.

WE trust very shortly to be in a position to make a very important announcement concerning an organization which we have been interesting ourselves in for some time past, and whose establishment, in the general trade interests of the country, is now being considered by some of the greatest commercial authorities in the United Kingdom. Particulars will probably appear in an early issue of this Magazine.

A SERIOUS reflection on the Secretary to the London Chamber of Commerce is contained in a communication we have received from one of H.M. Consuls-General abroad. He says:—"As for developing British trade I personally never lose an opportunity of doing so, and I never lose courage at the numerous failures to receive replies from the firms I address. On the 22nd September I wrote to the London Chamber of Commerce, transmitting enquiries for drawn iron tubing, but have received no sort of reply. Earlier still, I wrote the Chamber of Commerce making an enquiry for glass tubing, and sending a sample. There has been no reply at all." Has the Secretary to the London Chamber of Commerce any explanation?

WE are pleased to be able to present one of our special plates in this issue, illustrating this time the Westinghouse gas engine, now exciting so much interest and controversy on both sides of the Atlantic. The gas engine now being built by the Westinghouse Company to develop 1500 brake horse-power has three cylinders, 34 ins. diameter with a 60-in. stroke. The fly-wheel will be 19 ft. in diameter, and will make 100 revolutions a minute. The engine itself will be a Titan in size as well as in power among gas engines, standing 27 ft. high and 44 ft. in length. Further particulars respecting the principle of the Westinghouse gas engine will be found in another column.

THE acetylene business, after a mild attack of company fever, is quietening down, and now, we think, has every prospect of developing into a sober and well-conducted industry, with profit to itself and advantage to the country. It is now generally conceded, even by the most fervid of joint-stock promoters, that acetylene is not immediately destined to send every other illuminant to perdition. But there is no question, on the other hand, that as a light *de luxe* it is qualified to compete, and compete very successfully too, with paraffin and home-made coal-gas in isolated districts. In connection with this subject we may note that Professor Lewes, in our next issue, will open up another part of his subject in the interesting articles appearing in this Magazine.

IN view of the great public interest now being taken in the purification and disposal of town's sewage, we have pleasure in informing our readers that we have arranged with Dr. Rideal, F.I.C., D.Sc., who, as those interested in the subject will be aware, is one of the foremost scientific authorities on the question, to contribute to this Magazine what will prove the most

exhaustive series of articles in the bacterial treatment of sewage that has yet appeared. The articles will be copiously illustrated with photographic views and drawings, and the first article will appear in our issue of January next.

ANYONE at all conversant with current science must admit that there is a "fashion" in science as well as in other things. Just now, apparently, the absorbing topic is "wireless telegraphy." What, in our opinion, is a subject of equal if not more interest and importance was similarly, though in a more confined circle, a matter of enthusiastic debate several years ago, and we should like to see it revived. That is, the possibility of the direct conversion of carbon into electricity. We all know that this is supposed to have been already accomplished by experiments, from Dr. Borchers downward. But the experiments have never emerged from a crude state, and none have made the least pretext (if we except one American enterprise) to commercial practicability. May we look forward to future attempts to solve this entrancing problem?

IN our last issue, in the course of some observations regarding the Paris Exhibition, we mentioned a number of firms whose names were not before us as having been allotted space in the British electrical section. Four firms out of the sixteen referred to have written to us, one of them to say that their name appears in a supplementary list of exhibitors published after the issue of the first: the others explain that they are exhibiting in conjunction with other firms, which is the reason their names do not appear. We said at the time that our remarks might be subject to a qualification of this kind, but of course it does not affect our main argument.

We suspect that printing is more of a mechanical than an artistic industry, if we may venture to employ the term "industry" to an occupation which has consistently attempted to rank itself with the purely fine arts. The term "artistic printing" is very prevalent, but its meaning is confused, since the same term "artistic" is applied to the mediæval works of the sort exemplified by the late Mr. Morris, embodying what is known as "craftsmanship," and in the same sense to the mechanical results that have been brought to such a state of perfection in the United States. Both schools have their characteristic excellencies; but whereas in "Old Style" printing England has admittedly been, and now is, far ahead of the United States, we may point to the present and the past issues of FEILDEN'S MAGAZINE as a proof that in mechanical typographical excellence we are now at least on a level with our Transatlantic neighbours.

THE perfect governing of steam engines is a matter which does not yet appear to have been accurately settled. Theoretically speaking, a perfect steam governor does not at present exist. This important subject will be exhaustively treated in a future series of articles, especially with reference to high-speed engines.

AMONG numerous other congratulatory letters on our increasing success, we have been greatly pleased to receive from the hon. secretary of the "Young Men's Christian Association Chamber of Commerce of Newcastle-on-Tyne" a warm encomium on this journal. Mr. Crosier, the Honorary Secretary in question, says:—"I have followed with interest your endeavours to give the British Engineer a British Magazine." He says he is trying to do a little "in the same patriotic spirit." This is praise of a sort we particularly welcome, and trust that both work and sentiment as expressed may find a wide appreciation.

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NOTE.—This issue of FEILDEN'S MAGAZINE contains 12 pages more than the last number. The four preceding pages have been numbered 412 *a*, *b*, *c*, and *d*, respectively, as they had to be added after the bulk of the Magazine had gone to press.

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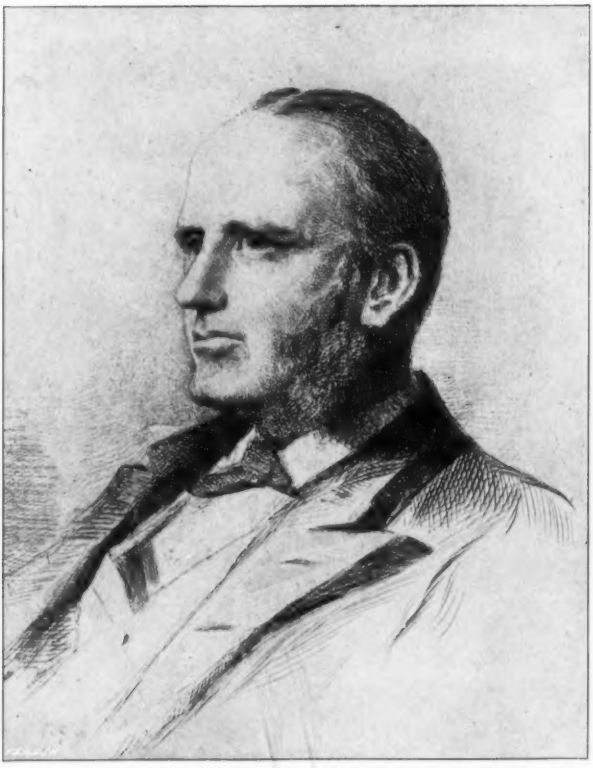
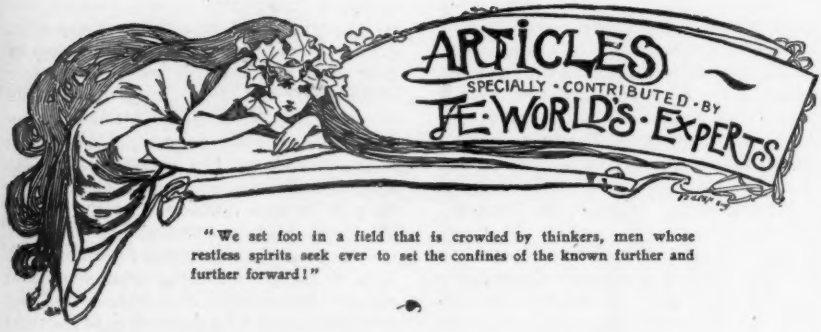


SIR EDMUND H. VERNEY, BART., F.R.G.S., F.R.M.S., ETC.



"We set foot in a field that is crowded by thinkers, men whose restless spirits seek ever to set the confines of the known further and further forward!"

The Education Bogey.

By Sir EDMUND HOPE VERNEY, Bart.

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Sir Edmund Hope Verney, Bart., was born in 1838, and has had a most distinguished military, naval, and political career. For some years he has devoted attention to questions of Political Economy, and is, as may be gathered from his present contribution, an ardent believer in the development of Public Education.

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The attitude of the English people towards education is a singular one; there is nothing like it in Europe. For many years past the Scotch have been alive to the commercial value of education; steadily they have grasped it and stuck to it. In the Scotch schools we have long seen the children of the well-to-do learning on the same bench with the children of the poorest; the Scotch have realised that the mind must be as well nourished as the body, to make the perfect man, and so the Scotch have gradually monopolised places of trust; they are everywhere to be found as foremen, bailiffs, gardeners, estate-agents, and so forth.

In Wales the history of education has been quite different. About twenty years ago the nation suddenly awoke to the fact that the fulfilment of its national aspirations might be realised by the higher education of Welshmen. This inspiration flew through the country like wildfire. It was enthusiastically taken up by every class, except, of course, the squires, the parsons, the peers, and the bishops, who, with some noble exceptions—notably the late Lord Powis and Dean Edwards of Bangor—did all they could to thwart it. Enthusiastic meetings were held in remote mountain villages. Close-fisted farmers pulled out hoarded money from old stockings. The ancient Welsh people became suddenly young again, and the force of this wave of feeling carried all before it. With his usual tact and foresight the Prince of Wales saw his opportunity. He came forward and placed himself at the head of this wonderful movement, and then it was quite comical to see the peers and the prelates, who had so strongly opposed it, meekly following in his train. So that to-day we see three flourishing colleges in the Principality, united in one growing University, and those who spoke pityingly a quarter of a century ago of poor little Wales now refer admiringly to gallant little Wales.

To take one instance out of many: at

this moment there is an indefatigable maid-of-all-work, living in a remote Welsh farm-house, invaluable to the farmer's wife as a trustworthy and untiring drudge; her brother, being fired with ambition, took a situation in a draper's shop, spent his nights in study, and finally gained a scholarship at a Welsh college. He passed out so brilliantly that he was offered a post as Nonconformist minister in England; but after two or three years he pined for his own people, and has returned to minister to a small congregation among the mountains of Wales. When his sister can get a short holiday, she spends it with him reading philosophy and theology—the highest happiness they both enjoy.

The chair of Moral Philosophy at the Glasgow University is filled by Professor Henry Jones, D.C.L., a former student there, and a Welshman, whose early career of toil and self-denial is equally creditable to himself and to Wales.

In Ireland the distracted state of the country, and the jealousies which we have so successfully fostered there, have prevented much real advance. It is as true now as it was when a celebrated wit uttered the remark, that whenever there is an Irishman to be roasted you can always get another Irishman to turn the spit; but the dawn of a brighter day is in sight, for there is no real hostility to education in the country, nor can there be apathy about it, because no Irishman is ever apathetic about anything.

In England, and especially in rural England, an entirely different state of things exists. A rural parish consists of three classes—the gentry, including the squire, the parson, the doctor, and the lawyer; then the farmers, including the shopkeepers and the publicans; and thirdly, the labourers and artizans. Now every one of these three classes is, speaking generally, not merely indifferent to education, but actively hostile to it. The

GENTRY DO NOT WISH TO SEE THE PEOPLE EDUCATED,

because that will make them independent. It is said to be this pernicious education that makes it difficult for the wives of the gentry to get servants. It is education that prompts a labourer to get on the parish council or the board of guardians, and take an independent line of his own; and it is out of the pockets of the landowner that ultimately the school-board rate comes. Only those who are behind the scenes know the intense and cruel selfishness which generally influences the action of the gentry where education is concerned.

Farmers, as a class, are, for their position, much less educated than any other class in the country. They have no wish for education, either for themselves or for their children. How then can they be expected to take any interest in education for others? Moreover, they want the boys to be at work on their land, not in school studying. It is rare in a country district to find a farmer who is at all up to date, or who wishes to be so. For dulness and sleepiness go to lectures on agriculture, where you will probably find no one among the students practically connected with that science. The few agricultural colleges in the land are regarded with very little interest by agriculturists, and the students they turn out would not bear comparison for thorough knowledge and sound training with the students of other colleges.

AGRICULTURISTS GENERALLY DESPISE AGRICULTURAL EDUCATION

as a fad not worth troubling about.

And, then, as to the labourers themselves. How can they be expected to care for education, when as children they are sent out with their education "finished" at the age of twelve—just the age when the children of the wealthier classes are beginning theirs? All that the labourer wants is to get his child out of school as soon as possible, to add the mite of his wages to the family income.

Then, how is it in the towns? If you converse on the subject with the man on the top of a 'bus, with the man in the street, with the shopman where you deal, or with the city clerk, you will find that one and all protest against the exorbitant school-board rate. Let a lively platform speaker at a political gathering turn to the

subject of education, and he will at once lose the sympathy of his audience. Broadly speaking, the

ENGLISH PEOPLE OF EVERY CLASS DISBELIEVE IN EDUCATION.

The usual talk at the tables of the rich is about the folly of requiring a high standard of education for those who enter the public service, and this always has been so; the prophecy has been freely made that, as we insist on higher intellectual culture from our soldiers and sailors their courage and their heroism will fail them. Perhaps Lord Kitchener and his immediate staff are among the most highly educated officers we have in the army, but their courage and heroism did not fail them last year. On the contrary, their brilliant success was mainly due to the highly skilled organization and science which characterised their operations.

A correspondence has been recently published in a leading daily paper on the depopulation of the rural districts. The question is from time to time brought before our local Chambers of Agriculture, where it is satisfactorily accounted for; that is, to the satisfaction of the farmers who attend. It is said to be all due to this absurd education, which puts new ideas into the lads' heads; but the truth is, that when a boy can read fluently, and study his paper and the magazines to some purpose, the aimlessness and hopelessness of his life are borne in upon him. He is governed by the classes, whose one aim is to keep down the rates, and who are necessarily hostile to such expensive luxuries as excellent schools, good water supply, efficient drainage, sanitary dwellings, free libraries, public recreation grounds, and the other accompaniments of an enlightened and progressive community. Rural land is, as a rule, in the hands of those who never sell an acre, and who have neither the will nor the power to encourage yeomen or small holders. So, naturally enough, the young man betakes himself to the town, where although rents are high, and the struggle for a living is intense, he does not find every avenue to success hopelessly closed against him. When he realizes the freer life of the town, he has no wish to return, for, whatever be his hardships and difficulties, he enjoys the freedom of his manhood. If we would keep the flower of our youth in the country, we must give him scope and hope; we must magnify all our local institutions and opportunities; village must vie with village in all that makes for progress and advance. There is no finer material in the country than the agricultural labourer, physically and morally. He has a sturdy frame and a simple heart. He loves his native village, and will be in no hurry to leave it if he has given him a fair chance in life.

The lamentable hostility to education which is found among all classes is somewhat less than formerly, but the improvement goes on far too slowly, for we are rapidly

LOSING OUR MARKETS, AND FALLING BEHIND IN THE COMMERCIAL RACE,

through the superior education and intelligence of competing nations.

An interesting proof that this is not a question of race or of inherited ability may be seen in the village of Histon, near Cambridge. Thirty years ago this was a purely agricultural village, with a typical population of the usual slow, dull, heavy agricultural labourer type. The vicinity of the University had worked no brightening influence in Histon; then began slowly to grow up the jam factory started by Mr. Chivers, a tenant farmer's son. It is now a large concern, up to date in every particular. There may be seen the most modern method of dealing with sewage on the septic tank system. Everywhere the factory is lighted by the electric light, hydraulic lifts are at work, coal is conveyed by a steam elevator to a store above, whence it descends to supply furnaces as required; a thousand horse-power steam-engine runs all the machinery. The labels and printing for the business are executed on the spot. Many of the diverse operations for producing jams, jellies, syrups, &c., require delicate manipulation and the highest skilled

labour. Now the interesting thing is that the whole of this complex factory is run by Histon men, the sons of agricultural labourers, and not by trained mechanics brought from manufacturing towns. Here you may see what grand stuff there is in the breed of the agricultural labourer, only awaiting its development by education. At the Histon factory you may see masons, carpenters, plumbers, draughtsmen, clerks, printers, chemists, electro-platers, electrical engineers, mechanical engineers, hydraulic engineers—all Histon boys. This shows what can be made of the precious material running to waste in our rural villages, which we often make no attempt to utilize, but are content to keep for our hewers of wood and drawers of water. Young fellows of high intellectual potentiality see before them no career but that of the day labourer, no relaxation or enjoyment but the public-house, no future but the workhouse and the pauper's grave. No wonder the most intelligent bustle off to the towns, where life is at least worth living.

The determination to win for himself a sound education is rare among Englishmen; in the New World it is common. In Germany also may be found many instances, and in all neighbouring continental nations

THE GENERAL AVERAGE OF EDUCATION IS FAR HIGHER THAN IN ENGLAND;

and so, year after year, the reports of our Consuls tell us of the loss of one market after another. In the manufacture of armour plates Germany has beaten both England and the United States. Since 1872 the entire volume of German trade has nearly doubled. Our Consul summarizes three causes which have mainly conduced to this astounding result: (1) No details are too insignificant to be considered. No trouble is too great to take in mastering minutiæ. (2) The commercial classes associate and co-operate for every kind of mercantile enterprise to an extent unknown in England. (3) The fostering care of the State is felt in every department of commerce. On the railways it is the home-producer who enjoys preferential rates. Now of these three causes, the first two are only possible with an educated community. The suspicion with which people regard one another in many of our industries is the outcome of ignorance. For her representation at the coming Paris Exhibition next year Germany has voted a much larger sum than Great Britain, and it is probable that visitors will believe Germany has passed us in many industries merely because England will be inadequately represented.

Now in this last year's report on Prussian education, Mr. M. E. Sadler tells us that "Education as a whole is regarded by the nation at large as a matter of fundamental public concern. Travellers find that small shopkeepers, workmen in factories, waiters in hotels, are alive not merely in a general way to the advantages of education but to the meaning and conditions of the different grades of schools which public authority provides." National energy and thought have been poured for a much longer time, and with much greater intensity of effort, into the German educational system than into the English. There is a national sympathy with educational aims which in our own country is wholly absent, not only among the poor but as much, or even more, among the rich. For nearly a century the science of teaching has in Prussia been closely studied; in England we have few students in this science. A German boy will learn English better and more quickly from a German teacher who has been taught to teach than from an English teacher who has made no scientific study of teaching; the value of scientific method in teaching becomes more and more apparent in every subject.

The essential thing in all education is the

PERSONALITY OF THE TEACHER.

Mechanical aids alone are not of much avail; the thing that breathes life into them all is the infectious personality of the teacher, and his influence will largely depend upon his being able to work up afresh in his own mind what he has to teach, and thus to impart to it a new, attractive and stimulating power.

This is the vital force in education, and the man who supplies this is worthy of his hire. It may be that the welfare of the nation depends even more on the selection and training of our teachers than on our educational system; in this connection it is encouraging to note that teachers are demanding higher and higher salaries, and that the necessity of providing highly-trained teachers, especially for infants, is becoming more and more recognised. The day has now happily passed away when the chief qualification for an elementary teacher was that he should be subject to some physical infirmity.

It must be advantageous to the country that every youth should aim at becoming a skilled labourer; there will always be an ample supply of the idle and the stupid for unskilled labour; and even in unskilled labour it is better for the employer to have it intelligently performed. The agricultural labourer will be worth more to the farmer if he has been taught the rudiments of his craft. By removing him at an early age from contact with books, and from all study, he loses what little facility he has acquired for mental exertion and becomes incapable of improving himself in after years.

Canada is showing us what British blood can do when educated and wisely directed. Avowedly and openly the

CANADIANS HAVE SET THEMSELVES TO CAPTURE THE ENGLISH MARKETS.

Every year the number of packages of butter sent from Montreal by ship is doubling. The Government provides cold storage on railways, steamboats, and warehouses. It may be noted that although one English county council does seriously contemplate establishing a cold storage depôt for the county, most county councils are too busy keeping down the rates to think of spending a penny to promote the prosperity of their counties.

The Reports of our Consuls abroad are practically unanimous in pointing to our lack of education as the reason why we are losing our markets; our price lists, printed in English, with the prices and quantities in English money and English measures, are hopelessly confusing to foreign tradesmen; the merchants of other countries send travellers conversant with the language of the country visited, bearing price lists with that country's money, and using her weights and measures, and so secure her custom. In most continental countries the metric system obtains, alike for money and for measures, and our complex notation is to them utterly bewildering.

While on the one hand it is encouraging to see the advance we are making, chiefly in the towns, and to know that each succeeding generation is more intelligent than the last, it is really heart-breaking to observe that our commercial rivals are making a good deal more progress than we are, not merely in winning success, but in deserving it. Their methods are open to us; their weapons are used openly and above-board; they are described in the Reports of our own Education Department, which hardly anyone finds time to read. Practical measures to forward our National Education are deemed likely to injure the electioneering prospects of those who are bold enough to advocate them, as they must mean increased expense, and Englishmen cannot be brought to regard outlay on Education as a profitable investment. This is a truth we shall have to accept some day, but so long as we reject and deny it we shall be beaten in the race by those who invest more lavishly than ourselves.

Edmund Verney.

A Revolutionary Invention in Weaving.

By Professor ROBERT BEAUMONT, M.I.Mech.E.

Director of the Textile Industries Department of the Yorkshire College.

Professor Robert Beaumont, the son of the late Professor John Beaumont, succeeded him in the position of Professor of Textile Industries at the Yorkshire College, Leeds, which he now holds. Professor Beaumont has taken an active part in furthering the interests of the Textile Industries in many directions, and is acknowledged the premier authority on textiles and textile machinery in Great Britain.

Less than a century ago there was heard, in such country villages as formed the centres of textile manufacturing, the click of the shuttle of the hand-loom weaver. No prophet was needed to foretell the gradual annihilation of this method of cloth construction, which had existed for generations, when the power-loom became a practical invention. Remnants of this old system still, however, prevail in the neighbourhood of Huddersfield, where plush weaving is successfully carried on, and the lover of the hand-loom—with the lack of restraint it imposed upon the weaver labouring under his own roof—may still hear that once familiar industrial sound in the silk-weaving centres of Macclesfield, Spitalfields, Lyons, St. Etienne, Crefeld, and Elberfeld. When Cartwright demonstrated by his rudely constructed loom, that cloth, like yarn, could be made automatically, he solved a problem which has been the source of an increasingly continuous series of inventions applicable to weaving machinery. Imperfect as his loom was in construction, it must ever be considered as a

MASTERPIECE OF INVENTIVE SKILL,

and the precursor in all its main principles of several types of the present day power-loom. Whatever may be the limitations of the modern power-loom, it deserves to rank amongst the highest inventions of human ingenuity.

Contrasts have been drawn between the spinning mule and the power-loom, the former, no doubt, being one of the most perfect compounds which the skill and wit of man have produced. Naturally, when the subject is considered in this light, much should be anticipated of a loom described as "a revolutionary invention in weaving."

First, allusion may be made to its negative characteristics. It should be distinctly understood that this power loom, so far as it has been perfected, does not accomplish two of the most difficult points in power-loom weaving, namely, the production of a variety of weave design, and of a variety of weft colouring or shuttling. Perhaps there are no two results more difficult of attainment by mechanical devices than these. Even the most perfect motions for this purpose impose limitations upon the designer which have not to be contended with in the use of the hand-loom, accounting for the survival of the latter in

the weaving of silk, plush, and decorative fabrics.

Another factor to be considered is that

THE POYSER LOOM

is for narrow fabrics, only an inch or so wide, such as tapes, ribbons, bindings,

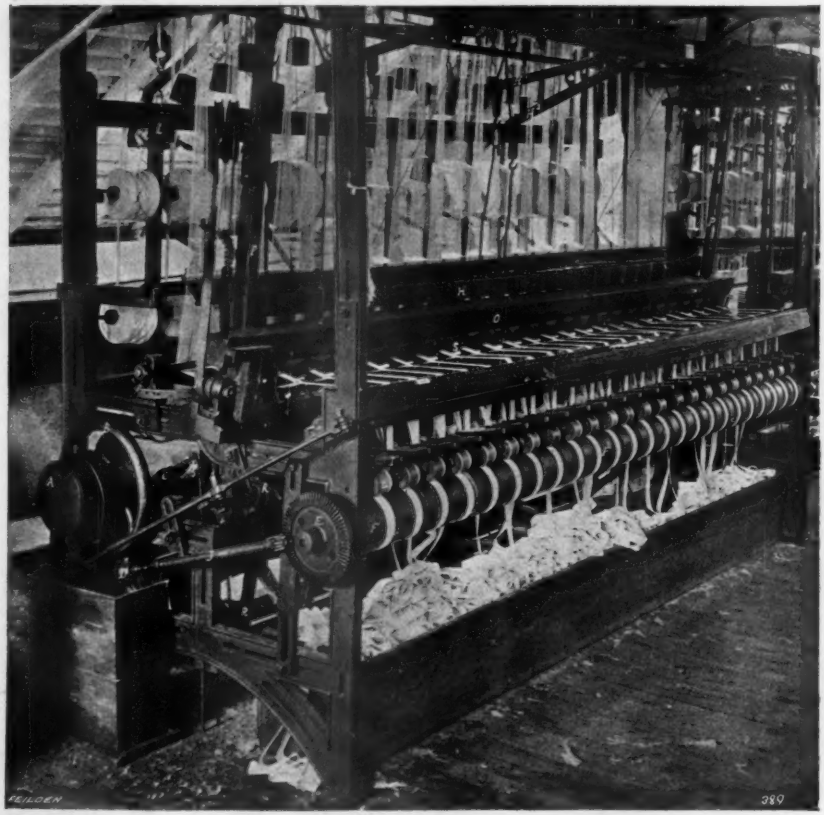


FIG. 1.—ORDINARY TAPE LOOM.

braids, and not for weaving pieces a yard, 60 inches, and even 100 inches in width.

In what sense, therefore, can this loom be said to be a revolutionary invention? Certainly not on the ground of its capacity for producing diversity of textures, whether in weave or colour effects due to the filling yarns; still it is so distinct in the principles of construction on which it is devised from anything which has hitherto been attempted in automatic weaving, that it is truly a new form, and not an old form of mechanism modernized and changed.

In respect to some of the mechanical elements of all known power-looms, it may be said that, however they may have been modified by the improvements of the mechanician, they still remain essentially the movements devised by

KAYE, THE BARBERS, OR CARTWRIGHT.

The old proverb, "There is nothing new

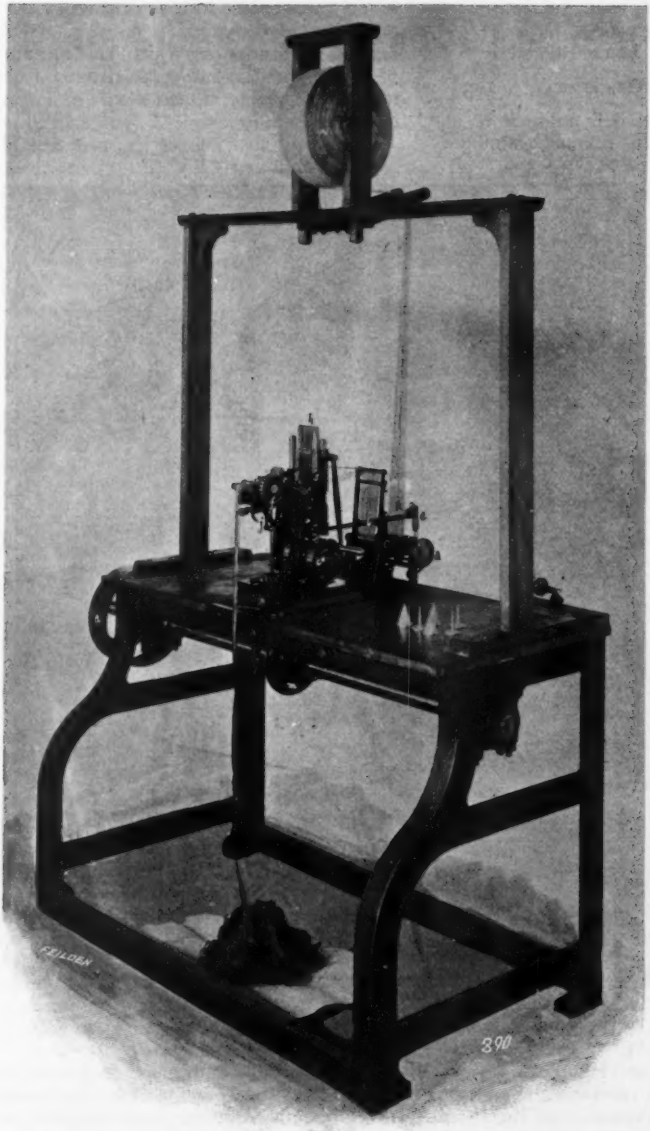


FIG. 2.—THE POYSER LOOM.

under the sun," may be applied with considerable meaning to some of the motions of the modern power-loom. It may be asserted, without fear of contradiction, that as regards the method of actuating the batten or going part, of shedding on the tappet or wiper principle, of picking, and of wefting, that there has been no bold departure from, or striking innovation in, the original mechanical inventions of the second loom of Cartwright; there has rather been the perfecting of an idea than the invention of a new principle, or what may be defined as natural mechanical evolutions, without evidence of the exercise of creative skill.

There have been inventions without number patented, which have had the influence of extending or further perfecting the essential principle to which they have been applied, but they have not supplied the loom with an entirely new or distinct scheme of parts for the purposes described.

As further showing how old ideas are utilized by the inventor of the times, we have only to mention that the bowl-and-chain arrangement for operating the heald shafts and shuttle-boxes in looms built on the American type, which was considered to be new but a few years ago, and appreciated by the manufacturers and practical men on account of its steadiness and certainty of action, was but a reproduction of the chain devised by Rostron, and patented in 1859.

Other instances might be given, such as the warp-stop motion attached to the healds in the Northrop loom, the germ of the idea of which is contained in one of Cartwright's specifications; or to a recent weft-stop motion applied to the shuttle, also one of Cartwright's ideas. But this is not necessary.

It is not with any object of disparaging or discounting what has been accomplished by textile machinists in the success of our weaving industries, for their progressiveness and trained ingenuity are beyond dispute, and have been the main factors which have enabled British manufacturers to compete successfully with their foreign rivals, but rather of emphasizing the fact that the principal motion in Cartwright's loom exists with improvements in the present-day loom.

In all mechanical work and industrial operations it is questionable whether those in the know are the most likely or competent to initiate a new idea or strike a new vein. They, perhaps unconsciously, become conservative in their views as to the possibilities of new methods, for they have been familiar with the growth of an old form of mechanism which has been made increasingly useful and effective by improvement after improvement. It may be they have seen a certain machine in its undeveloped and unperfected state, and had to superintend its action during the process of metamorphosis which has transformed it into a wonderful and perfect invention in their eyes.

No doubt here are some of the

CAUSES WHICH RETARD THE ADOPTION OF REVOLUTIONARY DOCTRINES

in mechanism for industrial purposes. At any rate, the absence of such elements in the constitution of the typical Yankee, makes the American race probably the most inventive and go-ahead in the world. They recognise

NO FINALITY IN MACHINERY,

leaving themselves at liberty to change from the old to the new at will, whatever may have been their love for the former.

It is, therefore, in some senses, not extraordinary that we have before us a decidedly novel build of loom devised by an outsider and one not familiar with the construction of the ordinary power loom. No expert would have been daring enough to have attempted placing the shuttle containing the weft yarn behind the sley or reed, and of dividing the latter in two for the insertion of each pick of weft, which is one of the leading and distinctive features of the Poyser loom, and of itself sufficient to merit its being defined as "a revolutionary invention in weaving."

An outsider was required to attempt this apparently impossible and what appears an unnatural step in power-loom construction. Had the inventor been in any way associated with weaving for any considerable period of his life, or had he possessed a fuller knowledge of the compound motions in power-looms used in the production of fancy fabrics, he probably would have approached the subject of devising a totally new weaving machine with less anticipation of success. Fortunately he was unhampered with a past that would have restricted and confined his ideas. The story of the accidental but fortuitous manner in which he was attracted by textile mechanics is likely to prove a part of the history of the development of the loom. Having, as one entirely unacquainted with weaving, visited a tape manufactory, he was struck not with the perfection of the spinning machinery but with the

CRUDENESS OF THE LARGE AND HEAVY LOOMS

for weaving such narrow fabrics. On expressing his opinion to this effect to the manufacturer, he was strongly advised not to attempt the task of the improvement of

machinery which was the result of the combined thought and skill of many inventors. Evidently Mr. Poyser's object was not to improve but to re-construct, has been obvious to experts in weaving, the chief stumbling block in the way of any great change in the construction of the loom was—

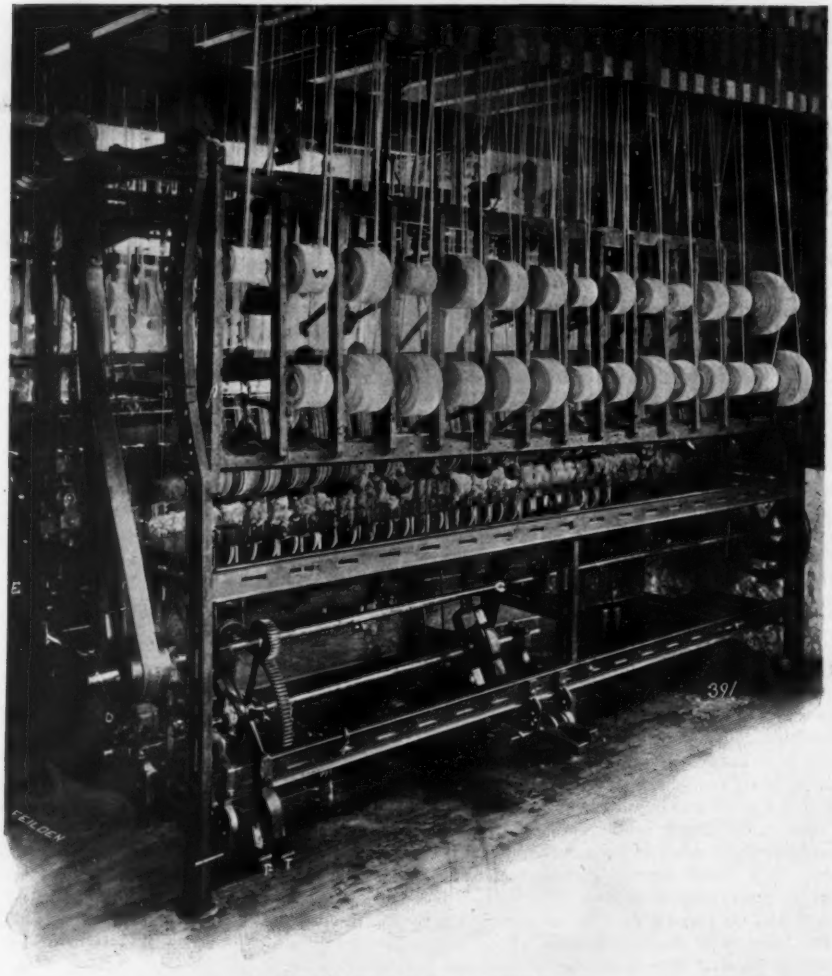


FIG. 3.—ORDINARY TAPE LOOM: ANOTHER VIEW.

and without making his purpose known he commenced the construction of his tape loom.

Strangely enough he discovered, what

THE METHOD OF SHUTTLING.

The shuttle receives in the wide loom a heavy blow, causing it to travel rapidly across the warp, so that to prevent its

rebound it has to be checked on reaching the opposite side of the loom. The propelling and retarding force thus exercised cannot fail to cause much strain on the working parts of the loom.

For some time he endeavoured to solve a different method of conveying the weft into the cloth, and the present idea of dividing the sley, allowing the tongue of the shuttle to pass between the division effected and lay the pick of weft into its proper place, was suggested by observing some unknown individual raise his spoon from his plate and put it into his mouth. So the loom may be said to have its jaws which divide the reed, corresponding to the opening of the mouth, whilst the projection of the shuttle feeds the weft at the right moment into the fabric.

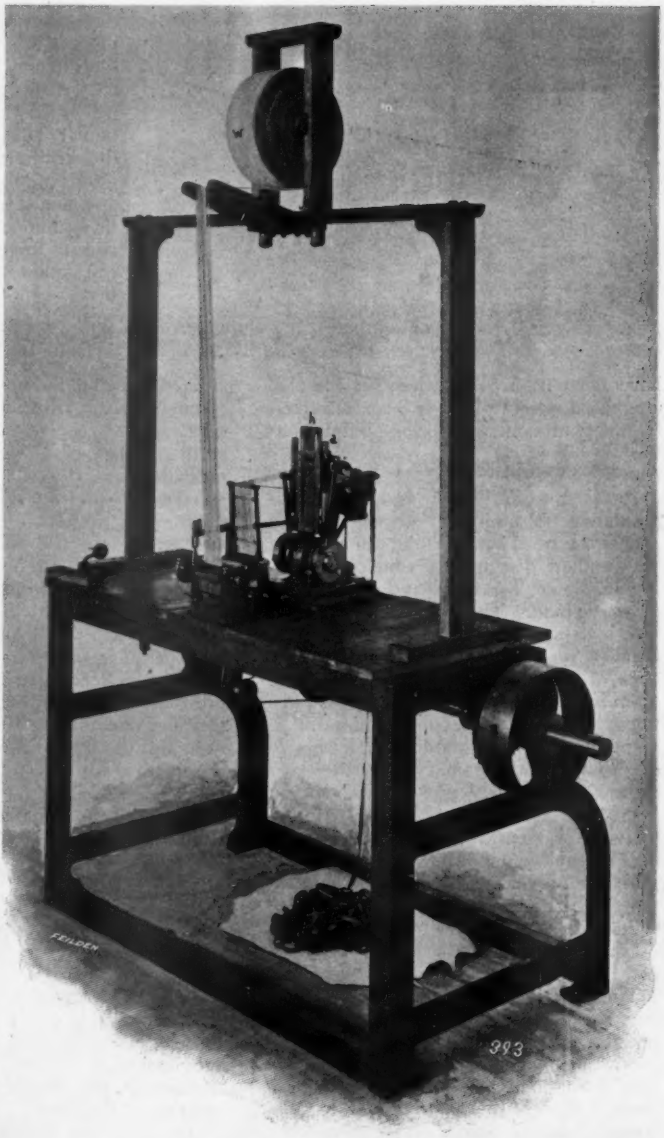


FIG. 4.—ANOTHER VIEW OF THE FOYSER LOOM.

We have now some clue why the old principles revered by the weaver, loom maker, and manufacturer alike, should

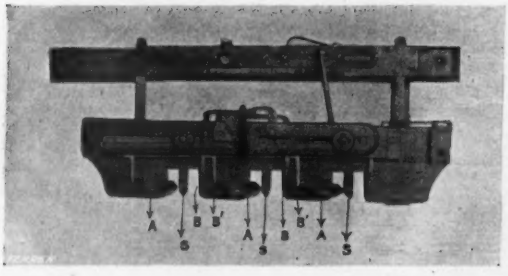


FIG. 5.—SHOWING TYPE OF BATTEN AND SHUTTLE IN NARROW-FABRIC LOOMS.

have been utterly discarded, yet the task attempted would fitly have been described by ninety-nine men out of one hundred as the

UTOPIA OF A DREAMER.

As seen from Figs. 1 and 2, there is absolutely no similarity between the old and new type of loom. They are as different in their design and construction as the engine of Tavistock and the modern steam turbine. The old loom (Fig. 1) is 9 ft. high and 4½ to 5 ft. wide, the new loom (if the warp is taken direct from the cops or bobbins) 2 ft. 9 in. high, and the loom itself 14 in. wide. They are so distinct in mechanical construction as to seem, even to the initiated, as incapable of producing the same fabric, the only features which they possess in common being the motions necessary to the weaving of identical textures. The mistake of the builder of the ordinary smallware loom is that of constructing it essentially on the lines of the loom for weaving wide fabrics. There is the same system of shedding, of beating up the weft, and with the exception of one or two minor details, of taking up the fabric. Thus, in Fig. 1, there are the usual heald shafts or heddles, *H*, the full width of the loom, producing several widths of tape; but in Fig. 2 the heddles *h* are of a different form, and made in metal instead of cord round wooden shafts. It should be observed that in Fig. 1 the complete loom, with its full complement of tapes, is shown, but in Fig. 2 only one head; but any number of these might be driven from the main shaft *A*. Whilst there is one principal shaft in both looms, yet in the former, to repair any imperfection which may occur in any particular tape, the weaving of the entire series has to be interrupted; but in the latter, any single head or tape may be examined without the stoppage of the others driven from the same source; indeed, each head can be turned over separately by hand, but in Fig. 1 only by power.

When the motions are examined in detail, the novelty and neatness of the new loom will still more forcibly contrast with the crudeness and imperfection of the mechanism of the old loom. The ordinary loom, shown in Fig. 1, primarily receives motion from the pulley *A* on the main shaft, which is cranked at either end, and connected with the batten containing the reed for beating up the weft. All the motions of the loom are derived from this shaft. In the first place, it is connected to an end shaft carrying cams for operating (*a*) the shedding treadles, one of which elevates the front and the other the back shaft, and (*b*) the picking treadles, one forcing the shuttle *S* to the right and the other to the left. The take-up of the fabric is effected by motion being given to shaft *f*, turning wheel *E* on the end of the take-up roller *F*. Each width of tape passes round this beam, and the pulley *G* is fixed in a lever resting upon it; the weight of the lever and the pulley are sufficient to make the movement of roller *F* take up a width of fabric, which passes through the lever and over the delivery roller.

In Fig. 2, motion is derived from shaft *a*, which is not a part of the loom, but drives the grooved roller *m*, which in turn operates, as will subsequently be explained, the heddles and all other motions of the loom.

The principal motions in weaving are shedding, picking, letting-off of the warp, beating up of the weft, and taking-up of the woven fabric, and it will now be advantageous to describe how these have

been devised and perfected in the new loom.

The various systems of shedding hitherto developed may be classified as tappet, dobbie, and Jacquard. The shedding motion of this loom, simply contrived for working two or four heddles, only need be briefly described. The heald shaft *H*, Figs. 4 and 6, are mounted in a pair of frames and slide within suitable grooves, the alternate rise and fall of each being secured by means of the uprights *F*, Fig. 6, fastened in opposite positions to the circular plates, *G*, on the end of the principal shaft. The remarkable dissimilarity between this and the common system of shedding for small-ware looms deserves to be noted. The latter is illustrated in Fig. 3, where the cams operate alternately on the levers, which are directly fastened to the bottom of the heddles, these being connected together at the top, so that one heddle balances the other. Considerable vibration necessarily results as the heddles rise and fall, unduly straining the warp yarns. All this is remedied by the system illustrated in Figs. 4 and 6, where the heddles are absolutely rigid during the up-and-down movement, and have a perfectly uniform motion whether descending or rising.

The shed having been opened, a pick of weft has to be inserted, and the shuttling or feeding of the weft into the cloth forms one of the most distinguishing features of this loom. From time immemorial weaving, whether by hand or power, has been performed by passing the shuttle or weft carrier in front of the reed. Narrow-fabric looms possess a similar type of batten and shuttle to that shown in Fig. 5, in which *A* are the shuttles, forced by the projecting pins *B* to and fro. This sketch will serve to illustrate the complete change which has been made in the plan of shuttling on the new loom.

By placing the shuttle behind the reed, not only has a striking departure from ordinary mechanism for this purpose been adopted, but several distinct advantages have been attained. Firstly, the shuttle crosses the warp in the deepest part of the shed, or when the distance between the lower and upper layer of threads is the greatest; secondly, the movement of the batten has been reduced to a minimum; thirdly, the shoots of weft are laid parallel with the fell of the cloth.

The old method of picking necessitates the going part or batten travelling some five or six inches from the cloth before the picks of weft can be inserted, involving much friction of the warp threads by the come-and-go movement of the key through which they pass. This is entirely obviated

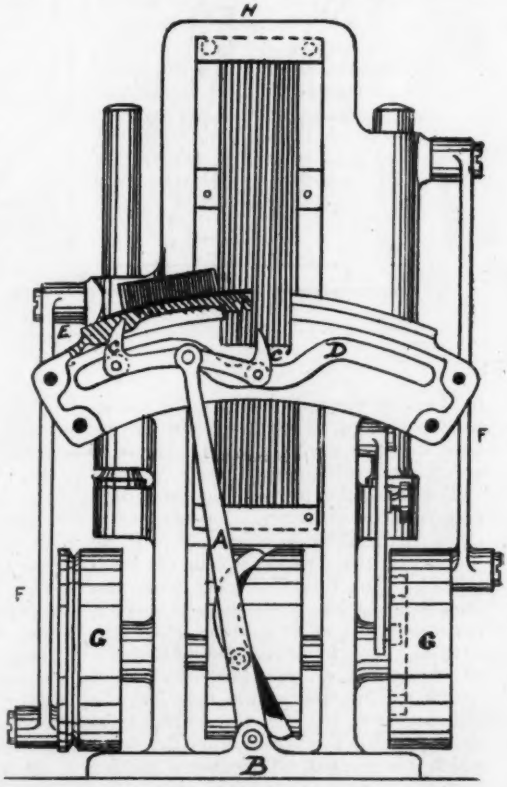


FIG. 6.—DETAILS OF SHEDDING MOTION AND SHUTTLE PROPULSION, POYSER LOOM.

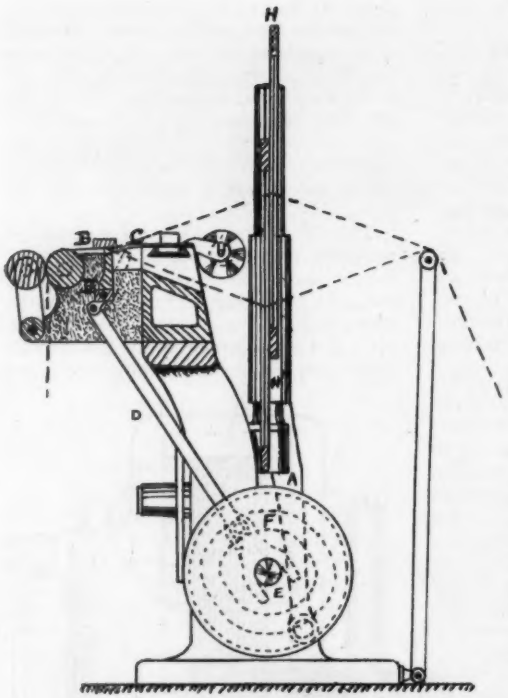


FIG. 7.—DETAILS OF FOYSER LOOM, SHOWING THE MANNER IN WHICH THE REED IS DIVIDED.

by reducing the movement of the batten to a fraction of an inch. It will also be clear that this effects a large increase of speed in the movement of the going part.

The last point is one of an interesting and valuable character, if a satisfactory cloth as to levelness of surface is to be obtained. It is a well-known rule in weaving that slack threads or slack picks produce more or less unevenness of texture, apparent either in its appearance, handle, or both. The improved system of filling or wefting removes an important source of irregularity in textural formation. In the ordinary loom the weft thread travels at an angle, which increases from the list to which it is secured, till the shuttle escapes from the warp at the opposite side. The reed then beats this pick of weft lying diagonally into a straight line, or against the last pick inserted, no provision being made for the removing of the slack weft yarn which results.

Now as to the method by which this change in the principle of shuttling has been obtained. Primarily, it should be understood that the shuttle is bridged and not driven or propelled across the fabric. There is, therefore, no variation of speed at the starting and termination of its movement, nor any liability to diverge out of its course. It is a fixed factor, being carried across a recess in the race of the going part by lever arrangement.

One method of propelling the shuttle is shown in Fig. 6. Here there is only one picking lever, *A*, having its fulcrum at *B*, and carrying a pulley working within the groove of the main shaft of the loom. The two fingers, *C* C^1 rise and fall alternately as the upper pulley on lever *A* slides in slot *D*. These projections enter the recesses in the bed of the shuttle, *E*, passing it from one side to the other in succession, lever *A* making two movements for each revolution of the driving shaft.

There is now to consider the manner in which the reed is divided. The batten is made in two parts, *B*, B^1, Fig. 7, and in one invention the upper portion, *B*, is fixed, the lower, B^1, moving to the distance shown by the dotted lines. When in the position illustrated, the two pieces and the reed directly coincide and beat the pick of weft into contiguity with the fabric; but if in the position shown by the dotted line, the shuttle bridges the warp and lays a pick of weft by its projection or tongue, *C*, over the lower parts of the reed. This accomplished, the batten is immediately brought into an upright position and the weft forced home. To effect the come-and-go movement of the batten, a lever, *D*, bifurcated and maintained in position by the main shaft, *E*, is

connected to B^1. This lever carries a pulley working within an eccentric groove, *F*, so that for each revolution of the main shaft two movements are imparted to the batten.

Two of the most important motions in weaving are the take-up of the fabric, and the let-off of the warp. The value of the uniform action of these to the weaving of a perfect cloth of whatever material made, cannot be over-estimated. The numerous inventions which have been patented for effecting these functions in weaving, are sufficient to show that hitherto, though many excellent contrivances have been devised, no perfect system of letting-off and taking-up has been produced. Both these motions in the Poyser loom possess newness, and from experiments which I have made to test their efficiency they are sensitive and certain in movement. Even a variation in the thickness of the weft is provided for.

The let-off and take-up levers are connected together, a pair of rollers of similar diameters being used for both take-up and let-off purposes. It will be understood that if levers *C* and *J*, Fig. 8 (take-up and let-off respectively), have corresponding powers, the take-up of the fabric would be equal to the let-off of the warp plus the length due to the bending of the warp threads around the weft threads. The length of cloth woven from a given length of warp varies according to the number of intersections of the warp with the weft, and also on the thickness of the weft threads and the amount of tension on the warp, but the last factor need not be taken into account in considering the principle involved here.

It is a question of lever *K* connecting the set-up lever *C* with *J*, and of controlling the amount of let-off in proportion to the take-up, and the uniform tension on the warp, by the oscillation of the vibrator lever *G*. The warp threads, after passing through suitable guides and between the let-off rollers *i* and i^1 are taken over the guide plates of the vibrator *G*. Bolted on to this vibrator is the plate *L*, in which is formed a slot L^1. The connector *K* is mounted with two pulleys, one of which slides in this slot, and the other in the slot of the let-off lever *J*.

When the tension on the warp is increased by opening the shed, the vibrator *G* travels towards the heddles operating against its spring *H*, so that the pulley end of lever *K* is nearest the axis of lever *J*, imparting to it the largest amount of movement. On the other hand, if the warp is slackened by the closing of the shed, vibrator G travels away from the heddles under the power of its spring *H*.

The merit of an invention is determined by its simplicity, its productive capacity, and its efficiency. The Poyser loom may be judged on these three grounds.

First, in point of simplicity it is far superior to the old form of loom, which it is destined undoubtedly to supersede. It is easier to manipulate, the motive parts are better under control, and the whole occupies such a small space that the operator may readily adjust any particular part of the loom. There is not that distinctiveness, as in the old loom,

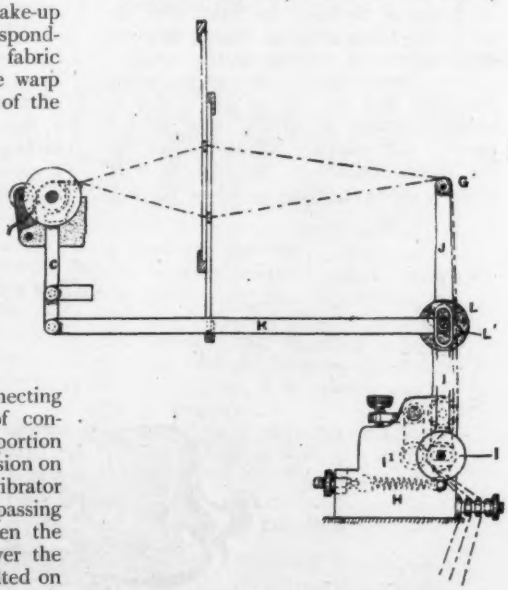


FIG. 8.—DETAILS OF LET-OFF AND TAKE-UP.

between the different motions for shedding, picking, let-off and take-up devices, all being in direct communication with one central shaft, so that it may fairly be said, on the ground of simplification of the loom, that the inventor has admirably succeeded.

In respect to productive power, it is scarcely more than necessary to mention, that whereas the speed of the old loom averages about 140 picks per minute, the new loom may be run at 500 per minute, without any additional wear and tear on the working parts, or undue tension and friction upon the warp and weft yarns.

The efficiency of the loom is proved, firstly, by the nature of the fabric it produces, which in points of evenness and regularity of structure, uniformity of picks per inch, and the accurate construction of the selvedge, is certainly equal, if not superior, to that woven in the ordinary way; and, secondly, it is determined by the actual working of the loom. The let-off of the warp and the take-up of the fabric, the insertion of the weft at the proper juncture in the opening of the warp, the laying of the same in a line with the fell of the fabric and not transversely, the short traverse of the batten, the bridging of the shuttle across the warp—saving vibration and the loss of power due to forcibly driving it on the race of the batten—the stoppage of the loom on the discontinuance or breakage of warp threads, or on the running off of the welt yarn, and the method of holding the fabric as it passes on to the take-up rollers—all indicate a combination of parts working in unison, and designed with a view of obtaining the maximum results with the minimum amount of mechanical details.

There are two great factors which contribute to industrial progress. On the one hand, the application of science and art to the industries, and on the other, the invention of machinery which will multiply productive powers. Whatever the skill and trained ability of the manufacturers, progress is accentuated or impeded by the kind of machinery available. The history of any industry is one illustrative of the

VALUE OF MECHANICAL INVENTIONS TO THE GROWTH OF THE MANUFACTURING ARTS.

Textile machinists have added their quota to that of the expert and trained technologist in the expansion of the weaving industries. The continental producers of woven textures, as well as those of America, have in the past

BENEFITED MATERIALLY BY THE MACHINERY DESIGNED AND BUILT IN THIS COUNTRY.

But in recent years they have become increasingly competent of constructing efficient machinery. The future will be a race between the home and foreign manufacturer and craftsman, and between their inventiveness, genius, and aptitude to devise textile mechanism.

Robert Beaumont

Some Recent Experiences with Steam Vehicles.

By JOHN I. THORNYCROFT, F.R.S., M.I.C.E., Etc.

Mr. John Isaac Thornycroft was born in Rome in 1843. He was educated at a private school and at Glasgow University, where he received a diploma. He established the celebrated shipbuilding works at Chiswick in 1866, and has been associated for many years with the development of high speeds in marine navigation. Mr. Thornycroft is F.R.S., Vice-President of Institute of Naval Architects, M.Inst.C.E. The author is now devoting a part of his attention to motor carriages, in which he has already achieved distinguished success.

The early history of self-propelled vehicles, so well treated in existing works, shows how attractive the idea of automobilism has appeared to mechanicians during the past two centuries. Such well-known and honoured names as Cugnot, Murdock, Symington, James Watt and Trevithick appear among the pioneers of the coming industry; and since their early attempts, a host of distinguished men have spent time, thought, and money in the endeavour to solve the interesting problem of the perfect self-propelled vehicle.

Steam, oil, coal-gas, ammonia, hot water, compressed air, electricity, and even other sources of energy have each their adherents. I here confine myself to an account of the use of steam as the means of propulsion, as I consider that for the transport of heavy loads this is, at the present time, the most suitable agent to employ.

The early experimenters had to

CONTEND WITH ALMOST INSUPERABLE OBSTACLES:

the general want of good roads off the great highways; the rudimentary condition of engineering manufacture, and the hostility of the mass of the nation rendered success impossible.

Our roads still leave much to be desired, though we believe the wheel difficulty is being gradually overcome. The hope of success in the present revival resides mainly, however, in the very greatly improved materials and mechanical processes of the present day, together with the employment of high pressures and quick-revolution engines, with consequent reduction of weight.

The last obstacle to progress has not wholly vanished even now; the utility of traction engines is still largely discounted by the

LEGAL RESTRICTIONS

imposed upon their use; the "Locomotives on Highways Act, 1896," though removing some difficulties, and giving an impulse to

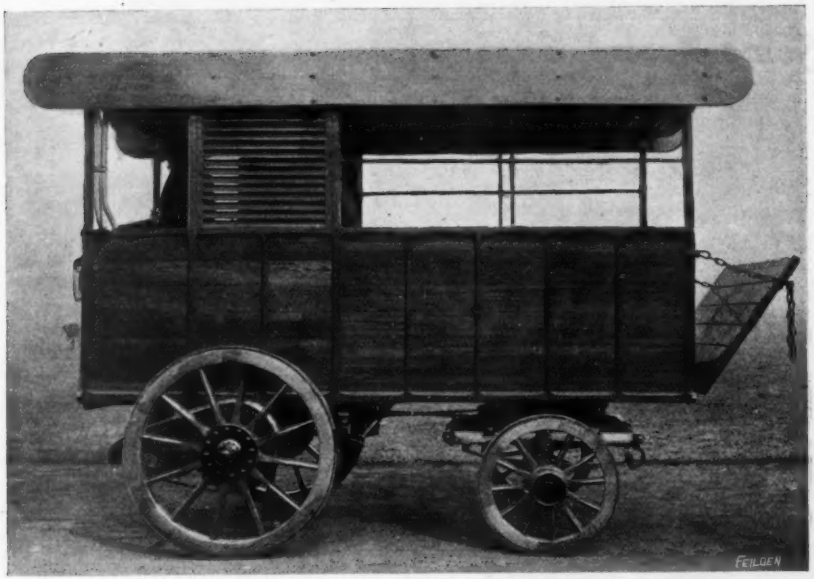


FIG. 1.—ONE-TON STEAM VAN.

the manufacture of the lighter types of road locomotives and self-propelled vehicles, must still, judged by the experience gained during the past three years, be considerably modified and rationalised before it can be regarded by engineers as a satisfactory measure.

The economy of the self-propelled vehicle for the carriage of goods or material increases with the useful load carried; and there is no doubt in the minds of those who have been engaged in the production of the heavier class of vehicle, that it is commercially impossible to build a durable vehicle, carrying from three to five tons of useful load, which shall not exceed the present legal tare of three tons.

I say *commercially* and *durable*, as it is quite conceded that an expensive and somewhat short-lived vehicle can be constructed which shall conform to the law and perform excellent service; but this is not a condition of things that will commend itself either to buyer or builder. One is at a loss to understand why our electrical brethren are

FAVOURED WITH A SPECIAL CONCESSION,

viz., that the weight of any accumulators carried is not to be reckoned as part of the tare of vehicle; may not makers of steam-driven vehicles reasonably urge that the weight of their boiler should be similarly excluded? Were this granted, the difficulties of commercial production would be somewhat lessened.

Instead of arbitrarily fixing upon a definite limiting tare, a more reasonable course of providing against undue damage to roads would have been to fix a

MAXIMUM LOAD PER INCH-WIDTH OF TYRE;

the most successful makers of heavy steam vehicles in France—who, I understand, are not hampered either as regards tare, speed, or number of vehicles hauled—have a ratio of tare to useful load ("nett") of from $1\frac{1}{2}$ to 3. I am of opinion, after considerable experience, that a quite satisfactory steam-

driven vehicle for 3 tons can be built to a tare of 4 tons, and maintain a "commercial speed" of 6 miles an hour with ease. But it is very desirable that heavier loads should be transported, and this may be done in two ways:—The motor vehicle may carry all the load, or a second vehicle bearing a portion of the useful load may be hauled. I suggest that the existing law be somewhat amended as follows:—In lieu of the present tare limit of 3 tons, a maximum load per inch-width of tyre be decreed; such load to be decided upon from an induction of cases of existing heavy-load horse-drawn vehicles. It can hardly be contended that this is other than a fair and reasonable suggestion; should it be objected to, however, one may recommend that the tare for 5-ton loads carried on one vehicle be raised to $4\frac{1}{2}$ tons; if carried on two vehicles, to $5\frac{1}{2}$ tons.

It is noteworthy that so long ago as 1832, a House of Commons Committee reported that: "As steam coaches admit of greater breadth of tyre than other carriages, and as the roads are not acted on so injuriously as by the feet of horses in common draught, such carriages will cause less wear of roads than coaches drawn by horses."

In considering the tare question one must also remember that owners are certain to frequently overload the vehicle, and that drivers, when pressed for time, are equally certain to over-drive it. Both these practices have to be met by greater strength, and therefore weight, in the vehicle, and are points to be kept in mind in the design.

Too much stress can hardly be laid on the necessity of building a *durable* vehicle. The early examples almost invariably soon showed signs of general disintegration, their boilers being especially a source of constant trouble. The boiler difficulty no longer exists, but the

FIG. 2.—TIP-WAGON OR STEAM DUST-CART.

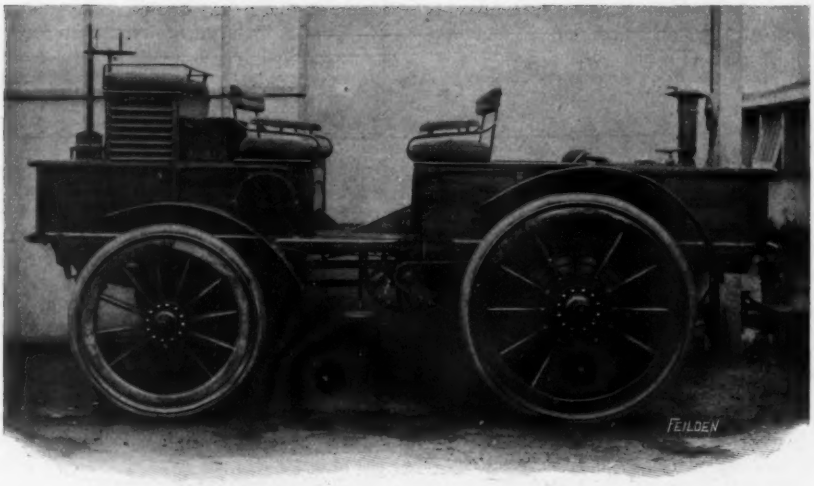


FIG. 3.—EXPERIMENTAL PASSENGER CARRIAGE FOR EIGHT PERSONS.

effects of road-shock and vibration require very carefully providing against.

About 1860 I first gave the subject some attention, and designed a number of steam-propelled vehicles. Pressure of other business obliged me to lay these aside, and it was not until some three or four years ago that I was able again to devote time to their consideration. The first result was the light van shown in Fig. 1, and constructed by the Steam Carriage and Wagon Company, Limited, of Chiswick. This van is 11 ft. long, 6½ ft. extreme width, and 9 ft. high, weighs about 30 cwts., light, and carries from 1 to 1½ tons of useful load at an average speed of 8 to 10 miles per hour.

The boiler is of the "Thornycroft" water-tube type, with tubular fire-bars, and has a heating surface of 50 sq. ft. Welsh coal or coke is burned. The engine is a small inverted double-compound, with cylinders 2 ins. and 4 ins. by 3-in. stroke, placed in the front of vehicle, upon the foot-plate. Motion is communicated from the crankshaft to a transverse countershaft, placed below the underframe, by helical toothed gearing. The countershaft carries the usual differential gear, and a pair of pitch chains with suitable sprockets connect the countershaft with the driving wheels.

This van is fitted with a single-speed gear only, and is rear-steering.

An air-condenser is carried on the roof. This is constructed of a number of very thin copper tubes, and exposes about 130 sq. ft. of cooling surface. Under normal conditions this is sufficient to condense nearly all the steam from the engine. The safety valve discharges also into the condenser, giving thus a silent and invisible blow-off. The weight of condenser, complete, is under 2 cwts. No vacuum is obtained, of course; indeed, unless care be taken, its use may result in a very considerable increase of back pressure. The condensed steam recovered often contains grease, and the evil effects of such water in boilers is well known. On the other hand, a small quantity of feed water only need be carried. There is a hot feed, and the lime deposit in the boiler is reduced to a minimum. In roofless vehicles it is difficult to arrange for an efficient air-condenser without the increased cost, weight and complication of an air-circulating fan driven by the engine.

In all the most recent vehicles built at Chiswick the air-condenser is omitted, and, it is believed, on the whole with advantage. The arrangements adopted are described later.

In Fig. 2 is illustrated one of the two tip-wagons, or steam dust-carts, built to my designs for the Chiswick Vestry, and which have been in regular daily service during the past two years.

The underframe, tipping-body and cab are of timber, the underframe being trussed. The tipping-body is fitted with patent screw tipping-gear, and has a carrying capacity of 6 cu. yds., which, in dust-bin refuse, weighs between 3 and 4 tons. The vehicles are often used on Sundays for the collection of road scrapings, and thus work a seven-day week.

The extreme length is 15 ft., breadth 6½ ft., and height about 10 ft. The wheel base is 8 ft. by 6 ft.; the weight, light, is about 3 tons; the rear wheels drive, and are 3 ft. in dia., with tyres 4½ ins. wide.

The engine is fixed below the underframe, and is a horizontal compound, with cylinders 3 ins. and 5 ins. dia. by 3-in. stroke. The cranks are at 180°, and the cylinders are placed on opposite sides of the crank-shaft, giving a nearly balanced engine, and promoting easy running at high speeds. The engine-frame, guides, valves, pistons, piston-rods and crossheads are of gun-metal, to prevent any damage to the engine by rust when at rest.

By means of a multiple-disc friction clutch (acting also as a fly-wheel) the engine is thrown in and out of gear with a shaft co-axial with its own, and carrying a toothed pinion engaging with the differential-gear spur-wheel on countershaft; from this shaft the transmission is effected to the driving wheels through a pair of Renolds' "Silent" chains with suitable

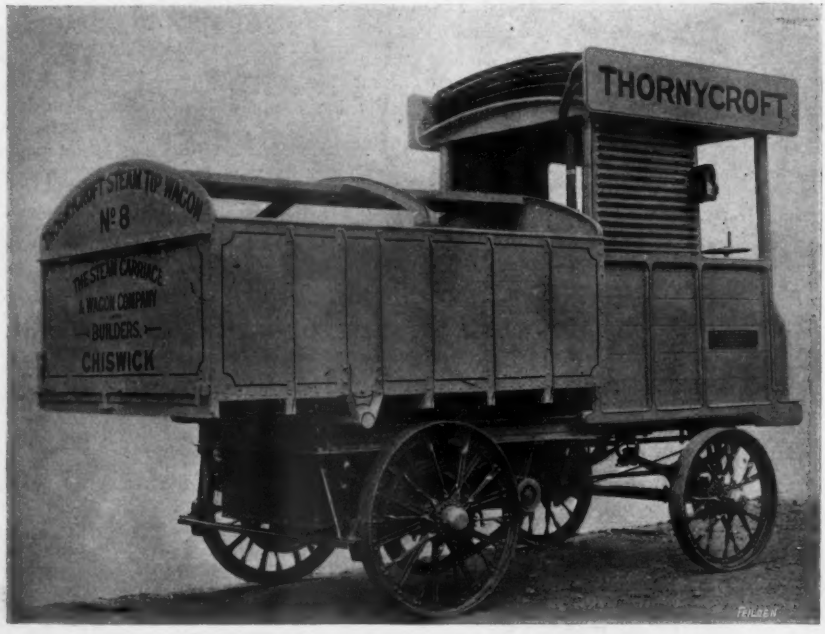


FIG. 4.—STEEL TIP-WAGON

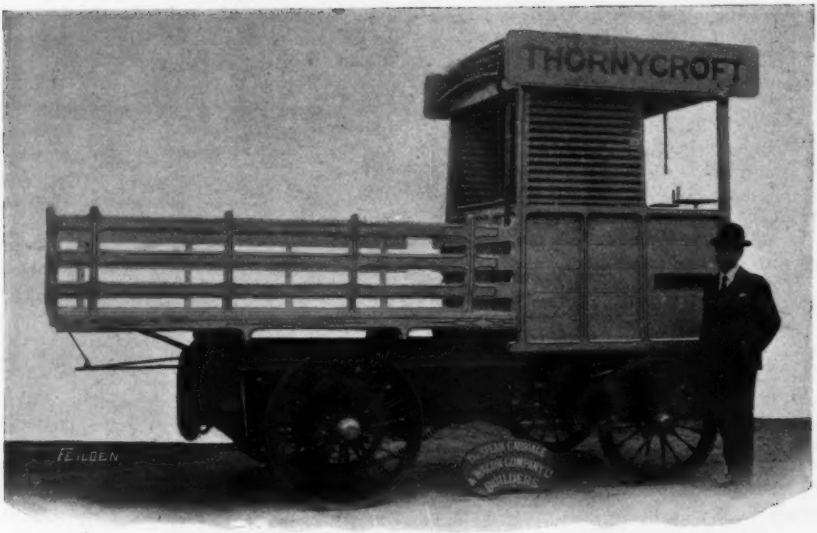


FIG. 5.—FARM WAGON.

sprockets. The use of a friction clutch is convenient for this class of work, in which the vehicle has to be frequently stopped.

Ordinary laminated bearing springs are used to support the underframe upon the axles. To prevent the play of the rear springs affecting the adjustment of the driving chains, a pair of radius rods—one of which appears in the figure—is introduced, connecting the countershaft with rear axle, and constraining latter to

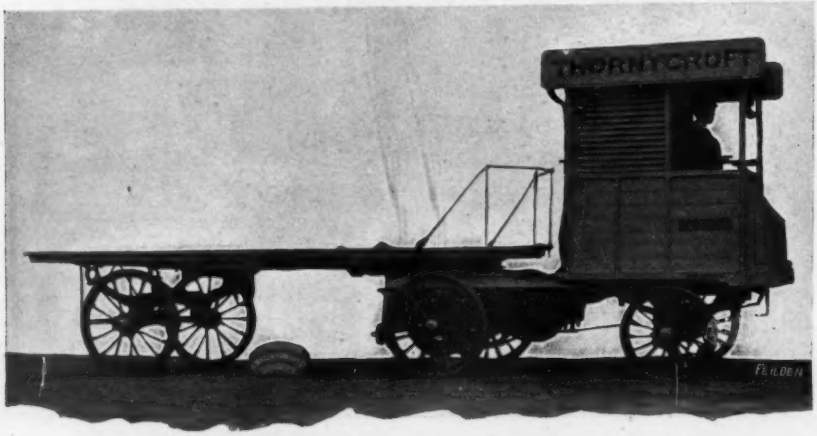


FIG. 6.—FIVE-TON LORRY. AN ARTICULATED VEHICLE.

move in a circular arc about the countershaft axis as a centre.

Steering is effected by the front wheels on the "broken-axle" method, through a worm-driven gear. The arrangement adopted provides for the correct differential turning of the fore wheels, satisfying the condition that their axes of rotation, produced, shall intersect on that of the rear axle. With this device, and the "jack-in-the-box" gear on the countershaft, perfect facility in steering is attained. The boiler is of similar type to that of the vehicle shown in Fig. 1, having water-tube fire-bars, and was fully described and illustrated in *Engineering* for August 30th, 1895.

These vehicles are fitted with air-condensers, carried on the roof, and having each a cooling surface of about 145 sq. ft.; the tubes are of copper, $\frac{1}{2}$ in. diameter, and 24 G. thick. Two years' experience with these vehicles has shown that the anticipated economy is fully realised in actual service.*

* *V.* District Surveyor's "Report to the Council," Dec. 1898.

In Fig. 3 is shown an experimental passenger carriage, having seating capacity for eight persons. This vehicle is fitted with a transmission essentially different from that of any of the others. The engine is similar to that of the Chiswick dust-carts just described, and is carried above the underframe. Both engine and boiler are carried at rear end of vehicle. The boiler is of water-tube type, of annular design, stoked from the top, and having the fire completely surrounded by tubes which connect the upper (steam-and-water) annulus with the lower annulus or bottom vessel. The necessary draught is created by means of a fan driven from the engine, placed in the funnel, on the so-called "induced draught" system. All the products of combustion pass through the fan chamber, and are then carried down along a trunk and discharged below the underframe directly rearwards.

The heating surface is 65 sq. ft.; grate area, $2\frac{1}{4}$ sq. ft.; and working pressure, 175 per lbs. sq. inch. The transmission from engine to countershaft is

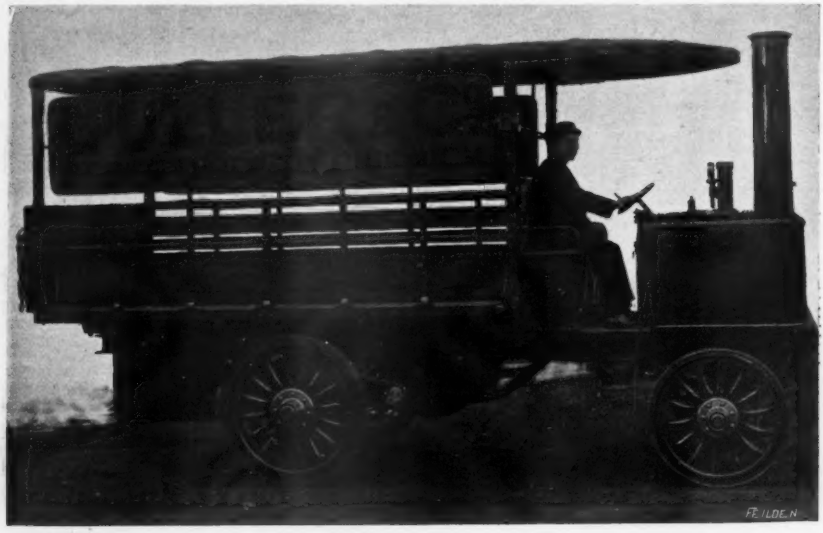


FIG. 7.—STEAM DRAY. DESIGNED FOR MESSRS. FULLER AND CO., CHISWICK.

by a link-belt drive; the engine shaft carries a flanged belt pulley, and is placed in or out of gear with the countershaft by a tightening pulley operated by the driver. The belt is received on the countershaft by two equal pulleys with flat rims, each taking one-half the belt width in ordinary running; this shaft is in two parts, placed co-axially, and driven respectively by the flat-rimmed pulleys; each part bears at its outer end a sprocket pinion, by which motion is communicated to the rear wheels through a block chain engine pulley, which is of rather small diameter.

An air condenser is fitted under the fore part of the carriage; this is of copper tubes, with radiating gills, and air-circulation is provided by a fan, driven from the engine, and visible in the illustration.

The over-all length of carriage is about 14 ft.; width, 6½ ft.; and height, 7 ft.; its weight, light, is below the 2-ton limit, and fully-loaded a speed of sixteen miles per hour has been maintained on ordinary roads.

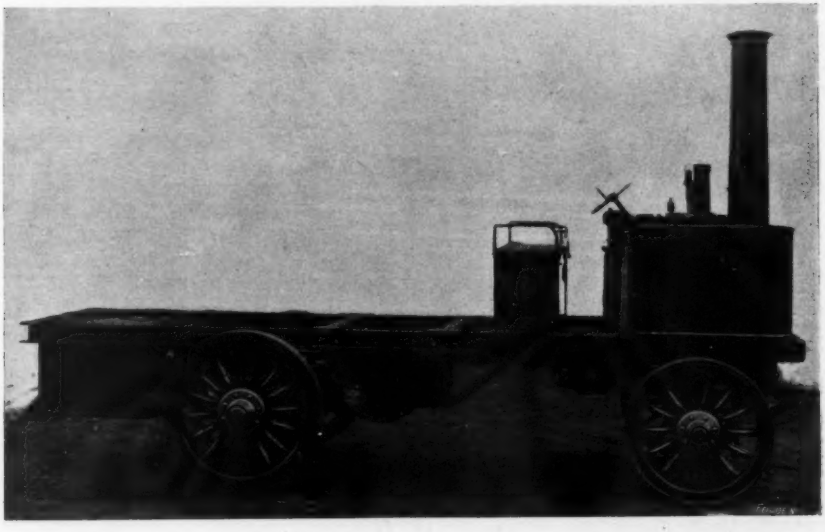


FIG. 8.—STEAM DRAY, WITH CARRYING-BODY REMOVED.

passing over a sprocket wheel attached to the driving wheel spokes. The action of the belt differential gear is as follows: On turning a corner the outer driving wheel rotates more quickly than the inner; the belt automatically moves from the more slowly moving pulley to the other, and thus not only permits, but directly *aids*, the necessary differential motion of the driving wheels, and the vehicle responds to the steering wheel with the greatest readiness. Some difficulty has been experienced, due to insufficient adhesion of the belt on the

In the steel tip-wagon shewn in Fig. 4, and succeeding vehicles, attention has been given to the advantage of separating the motor-part from the carrying-body, and of so arranging that after-bodies of various type can be easily and quickly substituted one for another, enabling one motor-part to perform a variety of services.

This vehicle has done much good work both as a tipping dust-cart (Fig. 4) for the Camberwell, Chelsea, Leyton, and Chiswick vestries, and as a "farm wagon," or wagon for general purposes at Birmingham Liverpool, and in and around London.

Without the carrying-body, the over-all length is 12¾ ft.; width 6½ ft., and height 10 ft.; the tipping-body has a carrying capacity of 6 cu. yds., and is of high-grade steel as used in torpedo-boat construction; the vehicle is designed for a useful load of 3 tons. A running speed, loaded, of 6½ miles per hour is easily maintained.

An air-condenser was originally carried on the cab roof; this has been removed, and the exhaust steam is now discharged into the base of the funnel, whence it issues invisibly, mixed with the products of combustion.

The boiler and driving arrangements are contained in the cab; the engine is attached below the channel-steel underframe, and the transmission is by machine-cut toothed gearing to the countershaft (carrying the differential gear), and thence by Renold "Silent" chains, to the driving wheels.

The engine is here rather larger than in the preceding vehicles, having cylinders 4 in. and 7 in. diameter by 5-in. stroke, and all working parts are enclosed in a dust-tight casing containing oil, the "splash" method of lubrication being adopted, as in the Willans, Westinghouse, and other quick-revolution engines. The engine is found to run for long periods without requiring adjustment, and the cost of the oil used is but a few shillings per month.

The boiler is similar to that of the Passenger carriage, in general disposition of parts (Fig. 3); the induced draught fan is, however, now omitted, the necessary draught being created by the exhaust blast. Coal or coke is used as fuel. The light steel wheels shewn in Figs. 4 and 5 proved unequal to their work, and it soon became necessary to replace them by others of stronger design; a set of steel disc wheels was constructed, somewhat heavier than the original set, but which have given excellent results so far. A feature of these wheels is the divided false tyre placed outside the ordinary tyre; this can be quickly renewed, piece by piece, as wear requires, without sacrificing the tyre proper. A single-speed gear only is fitted.

The vehicle illustrated in Fig. 6 was designed to compete in Class II. of the competition promoted by the Self-propelled Traffic Association at Liverpool, in May, 1898. Unfortunately there was no other entry in this class, so that a comparison of performance is not possible. The class included vehicles carrying a minimum of 5 tons on at least 110 sq. ft. of level platform area.

It was seen that this could not be done within the 3-ton tare limit; a compound vehicle was therefore constructed, coming under the 4-ton limit.

As shewn in Fig. 6, the vehicle is six-wheeled and articulated, the rear portion being attached to the motor part by a hinged turn-table permitting motion about both a vertical and transverse horizontal axis, thus relieving the vehicle from all strain due to inequalities in the road surface.

In general motive arrangements the vehicle resembles that just described (Figs. 4 and 5); a two-speed gear is fitted, however, in this case, the slow-speed drive giving a considerably increased turning effort on the driving wheels when on soft roads or stiff ascents.

The over-all dimensions are:—length, 25 ft.; width, 6½ ft.; and height, 10 ft.; the load platform is from 4 to 4¼ ft. above the road.

The speed attained in the trials proved rather lower than had been hoped, but much of the delay was due to the wheels (of similar design to those of preceding vehicle) showing signs of failure; the vehicle experienced difficulty also in backing into the "embayments," as required by the judges, owing to the rear part not being then easily controlled.

On the whole, it appeared that in many situations this type of vehicle would prove very serviceable. A speed of 3½ to 4 miles per hour was maintained with load, and the vehicle is equal to all ordinary manœuvres; but the tests imposed in the Liverpool competition were somewhat stringent.

Fig. 7 shews a vehicle, built to the order of Messrs. Fuller & Co., of Chiswick, designed to carry 3 tons, and haul a further 2 tons on a trailing lorry. Delivered towards the end of December last, it has since then run almost daily, and has already covered 4,000 miles on the road. On several occasions a load of 6 tons has

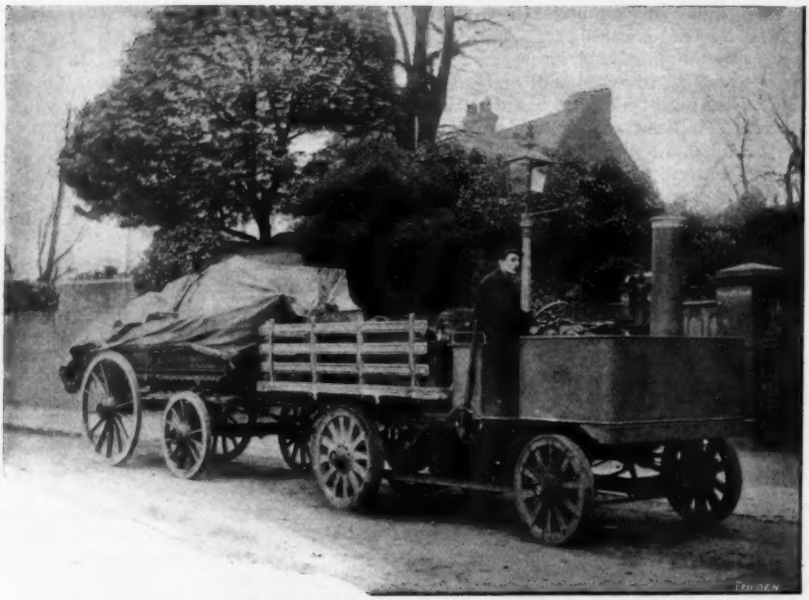


FIG. 9.—STEAM WAGON, WITH CHAINLESS DRIVE, HAULING A PORTION OF THE "SHAMROCK."

been taken; with 3 tons a speed of 6, and with 5 tons of 4½ miles per hour is easily maintained. The carrying-body is easily detachable, and is shown removed in Fig. 8; it has been made of large capacity (12 cu. yds.) to permit the carriage of a good load of "empties" on homeward journeys.

A log of the daily runs made has been kept uninterruptedly from the first, and an account also of all costs incurred by reason of adjustments and small repairs. The vehicle has made about 11,500 nett-ton miles, and the total cost, inclusive of interest, depreciation, wages, fuel, water, repairs, and stores is 3·1 pence per nett-ton mile. One may reasonably suppose that an owner of several steam vehicles would be able to still further reduce this figure.

Users should make adequate arrangements for the supply of water when long journeys are undertaken; further, vehicles occasionally develop small defects which, though generally trifling, may cause annoyance and delay if provision be not made beforehand. A room or shed, fitted with a vice, a few simple tools, and some spare parts, is necessary to all owners of self-propelling vehicles. Lastly, care should be taken in the selection of the driver, upon whom, in a considerable degree, the success of the vehicle may depend; he should be a reliable, intelligent man, able to deal with slight irregularities that may arise during running, and skilled enough to execute small repairs to vehicle when in the shed.

The boiler is annular water-tube, with fire carried in the bottom vessel in such manner that the tubes are preserved from contact with the ignited fuel. There is no air-condenser; the exhaust steam passes through a simple feed-heater, acting also as a silencer, and is thence discharged from a blast nozzle at base of funnel. The engine is similar to that of the vehicles illustrated in Figs. 4, 5 and 6. It will be noted that the boiler and all mountings are now in front of the driver but do not

obstruct his view; he is seated on the "off" side of a transverse tank containing feed-water, and has his pressure and water gauges in full view. The vehicle is completely controlled from this seat.

In all the preceding vehicles the final transmission is by a chain drive from countershaft to road wheels. One of the great difficulties in all self-propelled road vehicles has always been to provide a continuous torque on the driving-wheels, whilst at the same time permitting free and independent play to the bearing springs.

Chains, being flexible connectors, have met this difficulty, but not in a satisfactory way; unless made excessively large and cumbersome, carried in a dust-proof case, and continuously lubricated, they prove to have a very short working life, and the renewal of worn-out driving chains is an important item of expense.

Traction engine makers have long abandoned pitch chains in favour of toothed gearing for driving purposes, and have in some cases adopted wheels with unusually long teeth, and in others, a modification of the well-known "Oldham" coupling, to permit the small amount of spring motion ($\frac{1}{2}$ in. or so) allowed in their vehicles. Others, again, have employed an arrangement of bevel gearing and telescopic shafts. The vehicle illustrated in Fig. 9 contains a transmission devised by the author, in which no chains are used, and which may be briefly described as follows:—

The countershaft is driven by the engine through a toothed gear. The countershaft is in three parts, connected by a pair of specially designed universal joints, which permit also of a transverse sliding taking place; these joints being entirely enclosed are dust-proof and oil-retaining, and are provided with large rubbing surfaces, thus ensuring durability.

Between the extremes of no load and a "bump" with full load, there is a spring motion of six or seven inches, and this is taken up perfectly by the device described, without interference with the continuous torque exerted on the road-wheels, and without in any way straining the vehicle.

The differential gear is carried on the rear-axle. This axle turns in this vehicle, and is borne in axle-boxes, somewhat of locomotive type, attached to the under-side of the rear bearing springs. The rear wheels are driven by flat springs, attached to the main axle on the "off" side, and to the differential gear sleeve on the "near"

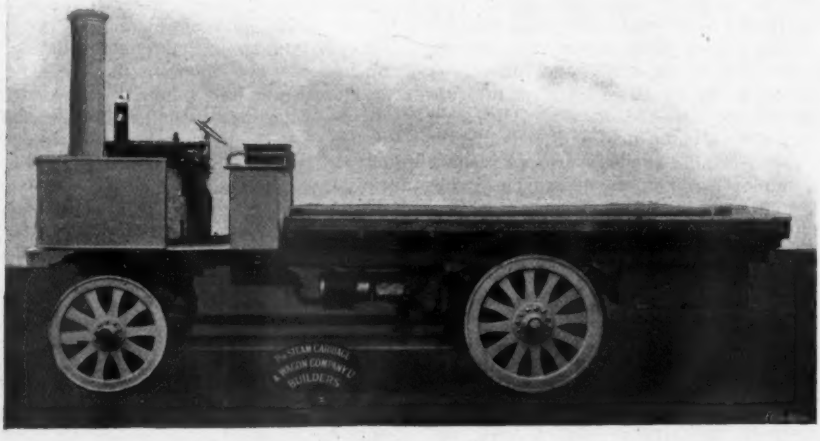


FIG. 10.—STEAM DRAY, BUILT FOR MESSRS. GUINNESS AND CO., DUBLIN.

side, pressing against suitable projections from the felloes. In this way the driving-wheel spokes are placed in much the same condition of service as in horse-drawn vehicles, and a yielding connection is obtained between the driving axle and road-wheels.

The wheels are stoutly built with oak spokes, ash felloes, and broad and thick steel tyres, and appear to last well in ordinary work.

An average speed of 7 miles an hour is easily maintained with a load of 3 tons. Two-speed gear is fitted, though, on good roads, gradients of 1 : 12 can be mounted with the normal or "high-speed" gear. On occasions when a greatly-increased driving effort is required the slow-speed gear is used, and this vehicle has carried a load of 3½ tons up a gradient of 1 : 6 without difficulty by its aid. On all ordinary gradients 5 or 6 tons can be taken; 3 or 4 tons being carried by the vehicle itself and the remainder on a trailing lurry.

The engine is enclosed, splash-lubricating, with balanced slides, and a special constant-lead valve gear, permitting any degree of linking-up or reversing. The boiler and controlling arrangements are similar to those of the Fuller dray already described.

Two safety valves are fitted, of which one discharges invisibly and silently from the funnel; the other, rising at a pressure 10 lbs. higher, blows directly into the air in full view of the driver, and thus draws his attention to the excess of pressure should the first fail to act. The main feed is by a pump driven directly by the engine; for the auxiliary feed an injector is employed. The engine can be disconnected from the driving mechanism, and run freely without propelling the vehicle. The working steam pressure is 175 lbs. per square inch. The illustration shows the wagon employed in transporting portions of Sir Thomas Lipton's yacht *Shamrock* from the works at Chiswick to the yard at Blackwall in which it was erected.

The wagon illustrated in Fig. 10 is designed to carry at least 3 tons, and haul a further 2 to 3 tons on a second vehicle. The motor vehicle itself is 17½ ft. long, 6½ ft. wide, and 8½ ft. high over all; the carrying-body is quickly detached, and after-parts of other type may be substituted if desired. With 3 tons a speed of 7 to 8 miles an hour is easily maintained, and with 5 or 6 tons of 4½ miles.

There is no emission of smoke or visible vapour, no noise of exhaust, and the gearing runs quietly and smoothly. The vehicle is completely controlled from the driver's seat. Water for about 20 miles, and coal for 40 or 50, is carried; for long heavy-load journeys a tank is fitted on the trailing vehicle also.

A "Thornycroft" water-tube boiler is fitted, with clinkering and cleaning arrangements; very light top and bottom covers, with special steam joints, permit of easy and rapid internal examination of the boiler being made; and all mountings are of the very highest class—a matter of importance where, as in this case, absolute steam-tightness is so necessary.

The engine is wholly enclosed with oil-bath lubrication, but is so designed that complete access is easily gained to every part; adjustment is only needed at intervals of four to six months. A constant-lead radial valve gear is fitted, having balanced valves placed below the cylinders, thus giving effective drainage. The engine is suspended from the under frame from three points, in such manner as to be relieved from strain due to any "winding" or distortion undergone by the frame.

The engine feed pump is carried and driven by the engine itself, and is of special design to meet the peculiar requirements of road service; the suction and delivery valves of pump are instantly accessible. The auxiliary feed is by a self-starting injector, so designed as to permit of cones being withdrawn and examined while boiler is under steam; two safety valves are fitted, as in the vehicle last described.

A two-speed gear and chainless transmission, similar to that of Fig. 9, is also fitted; the steering gear is, however, of new design, having all strains self-contained, and allowing free play to the fore bearing springs.

By placing the countershaft out of gear,

the engine may be employed in driving agricultural, electric, pumping, sawing, and other light machinery, if so required.

Welsh coal or coke is mainly used as fuel, though oil or inferior coals *may* be burnt in the boiler as fitted. Used intelligently, Welsh coal causes no smoke nuisance whatever; it burns noiselessly, and is cheap, safe and easily obtained. Oil is more costly, is not always easily procured, frequently noisy in burning, and oftentimes shows smoke and causes an offensive odour; it has the advantage of being somewhat cleaner in use than coal.

In its present form the steam vehicle is, in my opinion, capable of very successfully competing with any other existing method of heavy-load transport; but builders of these vehicles are much

HAMPERED BY THE 3-TON TARE LIMIT,

which necessitates the free use of aluminium and other expensive materials, together with the very highest class of workmanship in construction, with consequent considerable increase of cost.

And, further, as already pointed out, loads of more than five tons can, and must, be carried; but this cannot be accomplished as the law now stands. Amended, the auto-wagon for heavy loads will immediately become producible, commercially, on a large scale, on terms alike satisfactory to buyers and makers, and a boon to the business community at at large.

Experience has brought vivid realisation of the essentials of the problem, and especially the necessity of economy in details. For whereas we began with vehicles containing air condensers fitted with elaborate radiating arrangements, air-circulating fans, induced-draught fans, and various engine, boiler and other refinements, with attendant complication, there has subsequently been manifested a steady progress towards fewness and simplicity of parts, availability for various employments and to various conditions, ready accessibility, durability of construction, and centralisation of controlling arrangements.

To approximate to perfection in anything time is needed, and no doubt the next generation will use the experience of this as a stepping-stone. Yet, even in its present form, I believe the heavy-load steam wagon an economical and reliable carrier, and of its ultimate success I am quite assured.

John I. Thornycroft.

Machine Tools.

By EWART C. AMOS, M.I.MECH.E.

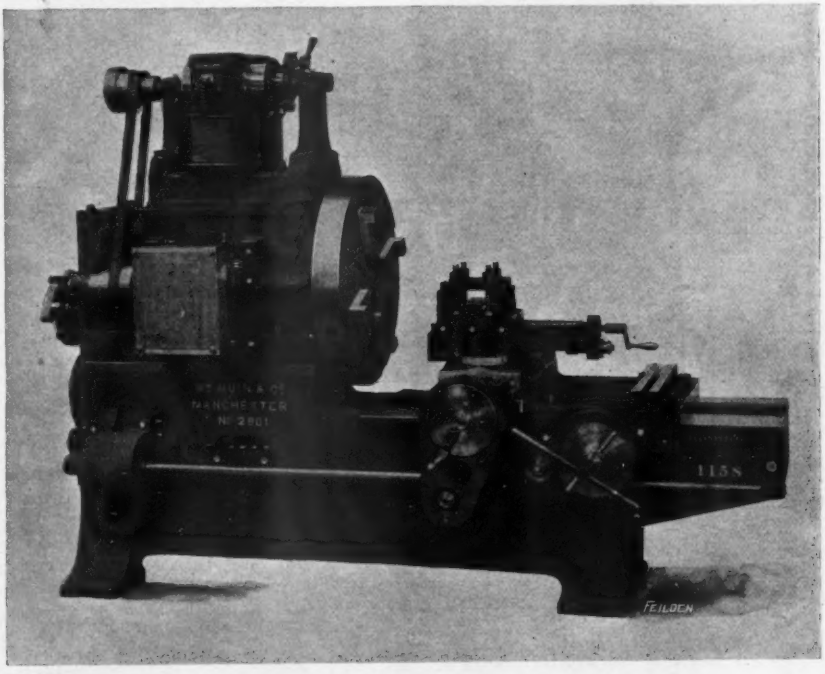
The Commercial Aspect, with Further Illustrations of British and American Machines.

(Continued from p. 356.)

THE commercial side of the question, in so far as it relates to the method adopted of selling machines, is so important a factor that some reference must be made to it, although of necessity brief. The writer is strongly of opinion that British makers would be well-advised if they could see their way to a more liberal exhibition of their goods than they have hitherto made. Speaking of London, there are few firms of note that exhibit their machines either directly or indirectly. It is true that several well-known agents carry English stocks, but even in this direction considerable change has taken place, since, seeing the advantages to be derived from the sale of American machines, they have reduced their British stock, at the same time increasing the American. Two reasons are to be found for this: In the first place, American stock was easier to get hold of, and at the same time secured good prices, whilst British-built machines have greatly increased in price, and the difficulty of obtaining them has increased in still greater proportion. This is now also the case to a large extent with American machines, and tools are being booked from America for delivery next midsummer. But this state of affairs is likely to reach a limit before very long, and then there will be a tumble in prices. It must not be inferred from this that the demand for tools will be greatly reduced, but rather that the power of output has been so immensely increasing of late that it must of necessity soon come up with the demand. Assuming, therefore, that a period of ease in demand, or, rather, greater equality between output and requirement, is likely to follow the present boom, it behoves those firms who, under the pressure of increasing business, have much enlarged their works (and there are many such) to provide some means for securing a continued sale of their goods in the future. The best way in which this can be done is by putting down stocks in suitable show rooms in all the important centres of distribution, and, what is equally important, securing the services of agents or managers who understand what they are selling. It is frequently the case that important business is entirely lost through the agent's ignorance of what he has to sell, coupled with an even greater ignorance of his customer's requirements. The day has gone by for the employment of the non-technical to do technical work, and the sooner this is realised the sooner shall we regain some of the position we have lost. Another important factor to be reckoned with is the American system of cataloguing goods. Whilst it must be admitted that great progress is being made here in that direction, the majority of British tool makers do not do themselves the justice of illustrating half of what they manufacture or in keeping their catalogues up to date. The attractiveness of our chief competitor's price lists is beyond dispute, and the amount of information which some of them contain is so great as to make one almost suppose that they were giving something away, a condition of things, however, that our Yankee friends can seldom be accused of. Apart from that, however, there is little doubt

that the fine blocks with which their lists are illustrated, added to the vivid description accompanying them, go a considerable way in securing business.

In the preceding article a description and illustration was given of an English and American radial drill, attention being called at the same time to the great improvements being effected in this class of tool. Whilst being one of the earliest it has still maintained its position as one of the most useful machines we have, and the illustration on the next page represents one of the very latest designs of American construction; in fact, the block was taken from a photo only just to hand whilst the machine itself has not yet been imported. A brief description of its salient features will probably prove interesting. It will be noticed that the column (which is of box section) is provided with a flat side, upon which the saddle carrying the radial arm works. This slide has a large bearing surface, and the arm can be rigidly clamped in position or raised and lowered by power. The arm itself is very stiff, and its weight is carried on ball thrust bearings swinging freely when unclamped. The rectangular table revolves upon the lower portion of the column and may be fixed in any position, whilst the support under the front of same prevents any chance of its springing. In the larger sized machines this is replaced with a square box table bolted to the bed-plate, but separate from the column. The head has a rack-and-pinion motion along the arm, with clamping device, and carries a counterbalanced spindle, provided with a quick return motion and automatic and hand feed



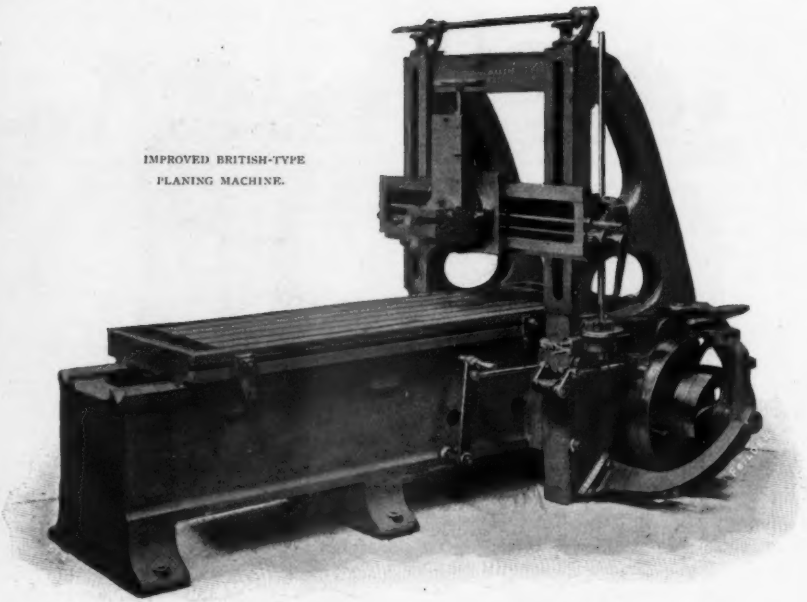
THE ELECTRIC-DRIVEN SURFACING AND BORING CHUCK LATHE.
(*Referred to on pages* 355-6.)

gears. A reversing motion permits of tapping, and it is so arranged as to be free from shock or jar when changing its direction. All gears are cased in, and the machine being self-contained can also be arranged to lie in line with or at right angles to the main driving shaft.

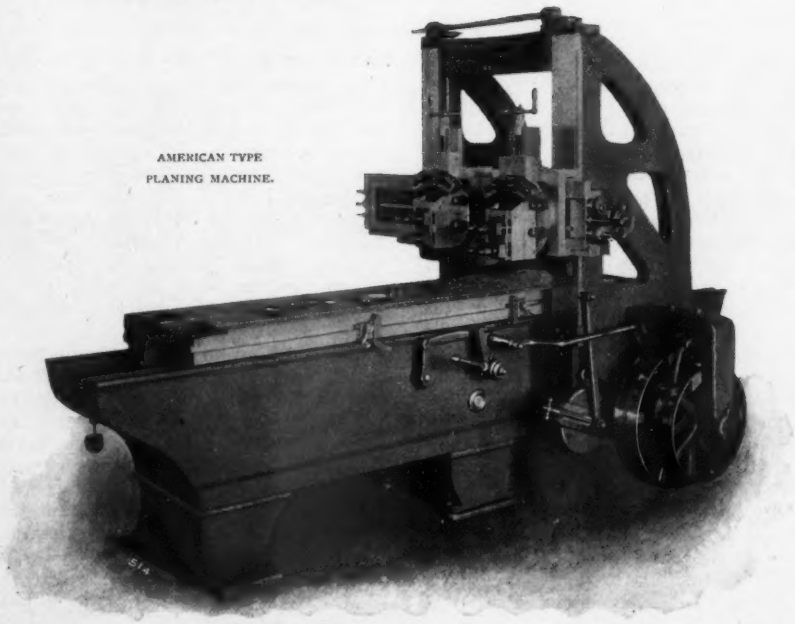
The drill illustrated has a radius of 2 ft. 6 in. with an admission under the spindle of 4 ft. to the base plate, the weight being about 1 ton, 4 cwt. In connection

AMERICAN COMBINATION RADIAL DRILL.

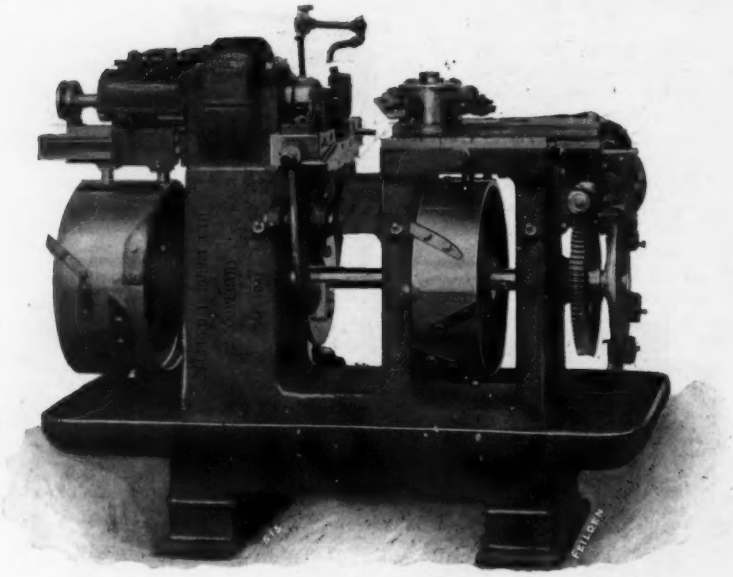
with heavy tools, such as planers, it is quite a common idea to suppose that the American tools imported here are mostly of the lighter kind, and so far as the heavy machines are concerned we have nothing to fear. This condition of things might have been true a few years ago, but the heavy tools are fast coming in. Only recently one of our leading armour plate makers in Sheffield installed, amongst other large tools, two very heavy American planers with a capacity of some 10 or 12 ft. square, specially designed for planing armour plates. These machines, besides being of solid construction throughout, possess several interesting features in design. One of these points may be referred to, and is in respect to the device adopted for applying the power required for driving the machines. This power is very considerable, and it was found that the width of belt required was so great as to be difficult to shift as rapidly as the purposes of reversal called for. To obviate this defect, the driving belt was divided into two belts, and the driving pulley was fitted with a loose pulley on either side of it, so that by shifting the belts in opposite directions at the same time they are either brought on to the tight pulley from its opposite edges or shifted on to the loose pulleys on either side of it, and in a more satisfactory and rapid manner than it would be possible to shift one belt of double the width from a fast to a loose pulley. The working belts are each 6 in. wide and run on 5-ft. pulleys, whilst the return belts are 7 in. wide and run on 4-ft. pulleys. The machines are rack driven, having steel racks 18 ins. wide by 3 in. pitch. The illustrations herewith show a British and an American planer; the former has a capacity of 6 ft. by 2 ft. 6 in. by 2 ft. 6 in., and the latter of 6 ft. by 2 ft. 3 in. by 2 ft. 3 in., so that they are approximately the same size. Whilst the general appearance is somewhat similar (with the exception that the American machine has two tool boxes), there is a considerable difference in design, and closer examination tends to show that in this case the advantage lies mostly with the English machine. The side chucks being carried down to the ground give great rigidity, and the gearing, which is placed inside the bed, is supported in its own frame, and has no bearings in the bed of the machine, as is



IMPROVED BRITISH-TYPE
PLANING MACHINE.



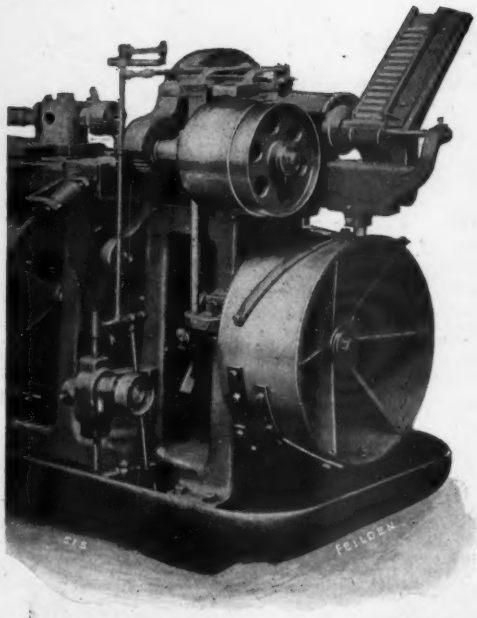
AMERICAN TYPE
PLANING MACHINE.



FULL AUTOMATIC SCREW MACHINE.

the case with the American machine, and, it must be added, in a good many types of British-built planers. This improved arrangement enables the gearing to be readily removed if necessary. The English machine has a cutting speed of 25 ft. per minute, with a reversal of 100 ft. per minute, which compares very favourably with American practice, although their iron is much softer than ours. This particular machine is really a very good example of what our manufacturers can do if they will revise their designs, embodying at the same time some of the American ideas with the best English practice.

The advantages to be derived from the use of the automatic machine have been already strongly advanced in the first of these articles, and will be dealt with again in subsequent ones. The type here shewn is what is known as a full automatic screw machine as made by a firm who have designed these machines on somewhat new lines. The illustration gives a general view of a machine capable of taking bars up to $\frac{7}{8}$ in. diameter through the automatic chuck. The object of the machine is to automatically produce all descriptions of pins, screws, collar studs, washers, bushings, or turned work of almost any description from bars of round, square, or hexagon section, being also specially suited for the production of projectiles. All the movements of this machine being entirely automatic, it follows that the work produced, besides being of a high quality, is also exceedingly accurate, being independent of any skill or want of skill on the part of the operator. A cam shaft running the full length of the machine carries a number of cam drums, to which are attached the cams for operating the different movements. For instance, the cam drum on the extreme left of the cam shaft operates the automatic chuck, also feeds forward the bar the exact distance required and closes the chuck again, it being also provided with variable adjustment. Next, on the cam shaft is a small disc plate carrying adjust-



END VIEW OF AUTOMATIC SCREW MACHINE, SHOWING MAGAZINE FEED ARRANGEMENTS.

able dogs for reversing the rotation of the head for screwing or tapping. The large disc plate underneath the cut-off rest carries adjustable cams by which the movement of the cut-off rest is controlled.

Following this, on the cam shaft, is the main cam drum, to which are attached the adjustable cams for moving forward, returning and rotating the turret which carries the various tools required. The cam shaft receives its motion from the large worm wheel shown at right hand side of the shaft, this in turn being driven by worm and pulleys at rear of machine. The cam shaft is provided with two speeds, the slow speed being used for actual cutting operations, whilst the fast speed (about 50 to 1) is required for the return movements and for bringing the tools up to their work. The correct speed is automatically given to the cam shaft by means of a series of adjustable dogs attached to the disc plate at the extreme right of the cam shaft.

Another illustration shews an end view of a larger size machine, capable of dealing with bars up to $1\frac{3}{4}$ in. diameter and fitted with a hopper or magazine feed arrangement. This is used for feeding-in detached pieces of work, such as studs, pins, etc., and two machines are worked together; the one machine, which may be termed the first operation machine, turns, screws, and finishes one end of the stud and cuts it off, whilst the second operation machine, which is fitted with a magazine feed, as illustrated, receives the studs in this condition and feeds them automatically forward through the spindle of the machine, and the second head is thus presented to the tools for threading and finishing. In a future article the advantages possessed by these machines will be considered, together with a description and illustration of one of the largest automatic screw machines at present built.

(To be continued.)

Ewart S. Amos

The next two articles our contributor will devote to a description of Pneumatic Tools, fully illustrated and containing particulars of the principal machines in use. Following these, the consideration of Automatic Screw Machines, etc., will be resumed.

Acetylene Generators.

By Professor VIVIAN B. LEWES.

(Part IV.—*continued from p. 344.*)

The third subdivision of the first group of generators contains those machines which owe their automatic action to the carbide holder or cage being directly attached to the bell of the gasholder, so that, as the holder falls, the carbide is plunged below the surface of the water in the holder tank, and, the generation of gas then causing the holder to rise, the carbide is once more raised out of contact with the water.

In the "Sunbeam" apparatus (Fig. 34), the automatic action of the generator is wisely not relied upon to do more than govern the rate of feed of gas to the holder, which is of sufficient size to contain the gas made from the largest charge of carbide the generator will contain.

The complete apparatus consists of a generator, condenser, purifier, and gasholder.

The generator (Fig. 35) is, in reality, a small holder *B*, working in the tank *A*, a water-sealed cylinder *C* carrying the carbide cage being fixed in the crown of the holder. The carbide in its holder is attached to the cylinder, which is put into place and is rendered gas-tight by means of the water seal, which is so arranged that by the time the carbide cage is

Fig. 34.—The "Sunbeam" Apparatus.

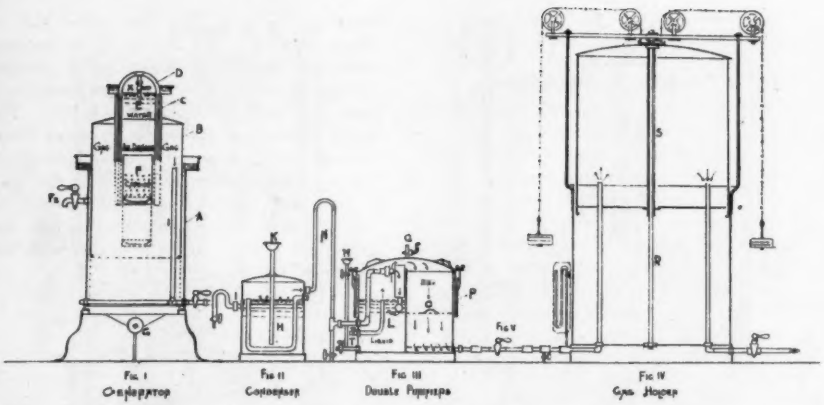


FIG. 35.—SECTIONAL DIAGRAM OF THE "SUNBEAM" APPARATUS.

lowered sufficiently to touch the water in the holder tank there is a seal of six inches of water to prevent escape. As soon as the carbide touches the water acetylene is generated, and if the gas comes off more rapidly than it can pass through the condenser and purifier to the main holder it accumulates in the generator holder, which, on rising, withdraws the carbide from contact with the water and slows down the generation, and when the generator holder again descends it once more plunges the carbide into the water and causes further evolution of the gas, this action continuing until the carbide is exhausted. The generator is fitted with a sludge cock *G* and a draw-off cock F^2, to regulate the height of water in the generator tank.

The gas is led from the generator through a condenser, where it is washed to free it from ammonia and is then led through the purifier, which is divided vertically into two compartments *L O*, in the first of which the gas is made to pass in thin streams through a layer of 1.5 inches of refined petroleum which washes it free from benzene and tar vapours; and the gas then passes down through layers of lime and oxide of iron, spread on perforated plates in the second compartment *O*, and on to the store holder.

The presence of the store holder enables the gas to be generated very slowly, so preventing any serious overheating and ensuring satisfactory purification.

The "Sardi" generator (Fig. 36) very much resembles the "Sunbeam" in its general arrangement. It consists of a gas-holder *C*, counterbalanced and floating in a tank *D*. A cylinder with water seal *B* passes down from the crown of the holder to level with its lower rim, whilst a short arm closed by the cock *H* connects the interior of the cylinder with the gas space in the holder.

The carbide is contained in a series of perforated zinc cells or trays *A* attached to the rod A^1, fixed to a cover which fits into the water seal, and in the top of which is a small vent cock to allow the escape of air whilst lowering the cover into the seal.

The outlet pipe from the holder is fitted with a catch box *F* to collect any condensed water or tar, and the gas passes to the outlet cock *E* and supply pipes.

In the original Sardi apparatus, the carbide was all contained in one long cage, but this gave rise to such serious overheating that it was afterwards subdivided into a number of small cells, which, to a great extent, diminishes this trouble.

The generation of gas in this apparatus is controlled by the rising of the holder

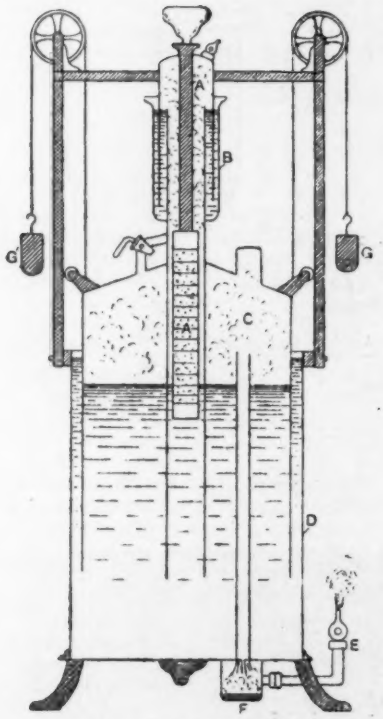


FIG. 36.—THE "SARDI" GENERATOR.

which withdraws the carbide from the water as it rises, and again brings it in contact with the water as it falls.

Another generator of much the same construction, in which the make of gas is regulated by the movement of the gas-holder, is the "Liver" or "Sovereign S. C." (Fig. 37). In this apparatus the moving bell *A* (Figs. 37 and 38) is provided with a central tube, in which is placed the carbide holder, the opening being rendered gas-tight by a screw clamp. The carbide holder consists of a number of cells, in which the carbide is placed, threaded on a central support by means of which the cells can be withdrawn or replaced.

On one side of the generator at the bottom is the gas outlet, fitted with tap *D* and having under it a tube with a screw cap *E* containing a sponge for filtering the gas. On the other side of the generator is the outlet *B*, in connection with the safety escape valve situated in tube *I*, and to which a pipe carried outside the building should be fixed. The tap *C* permits of the water-chamber being emptied when required. By means of the tap *F* communication between the gas-holder and the carbide holder can be cut off, and this is employed when the generator has to be charged whilst the lights are still being used.

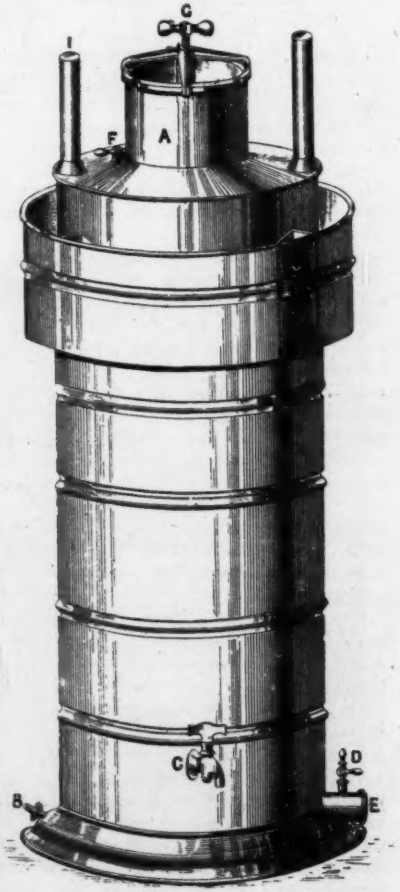


FIG. 37.
THE "LIVER" OR "SOVEREIGN S.C." APPARATUS.

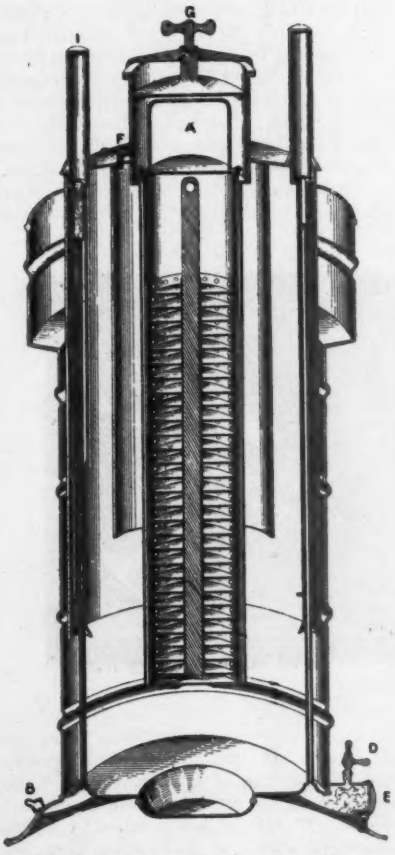


FIG. 38.—SECTIONAL VIEW OF THE "LIVER" OR "SOVEREIGN S.C." APPARATUS.

The "Abingdon" generator is automatic in its action, the supply of water to the carbide being controlled by the rise and fall of the gasholder. Fig. 39 gives an exterior view, and Fig. 40 a horizontal section, of this apparatus.

A square water tank *A* contains the moving gas bell *B*, within the hollow centre of which is fitted the inverted cylinder *C*, which acts as a generating chamber and also serves as a relief-holder if an undue pressure of gas should arise. Between the gasholder *B* and the generating chamber *C* a cylindrical open-topped vessel *D*, provided with a central tube, is placed, resting on the floor of the tank *A*. Around the central tube perforated cages for holding the carbide are disposed at varying heights, so that the water can attack the carbide in successive portions. The whole arrangement of generating chamber *C*, the bucket *D*, and supporting framework for the carbide cages works upon a central gas pipe, the lower end of which leads into a water seal to prevent a back flow of gas to the generating chamber. Owing to the generating chamber *C* and gasholder *B* being surrounded by water the gas is delivered to the service pipes in a cooled condition.

The foregoing descriptions give an idea of some of the more important modifications of the form of acetylene generators of the first division, in which at some period of the generation of the gas the carbide is in excess, and although many

FIG. 39.—THE ABINGDON GENERATOR.

of them work in a most satisfactory manner when the production of gas is normal, yet nearly all will show signs of overheating when the gas is too rapidly generated or the machine pushed to its utmost limits. Undoubtedly, of the three subdivisions the generators belonging to the first are the most satisfactory in action, whilst those of the second and third classes, even when working under ordinary conditions, are liable to give rise to local overheating at some point in the carbide charge. This at first sight seems of but small moment, but a little experience soon shows that, no matter how local the heating may be, it has certain drawbacks which should be prevented. Acetylene has the power of polymerising, *i.e.*, building itself up into more and more complex bodies as soon as the temperature to which it is subjected rises above a certain limit; and even when there are only a few local points of high temperature in the decomposing charge of carbide, some of the acetylene becomes converted into benzene, which is largely responsible for the troubles which have been found in the combustion of acetylene, being one of the causes that have led to smoking and carbonising of the burner tips, whilst if a serious rise of temperature takes place heavy oils and tar are produced from the acetylene and tend to foul the generator and gas exit pipes, and also reduce to a serious extent the volume of gas generated from a given weight of carbide.

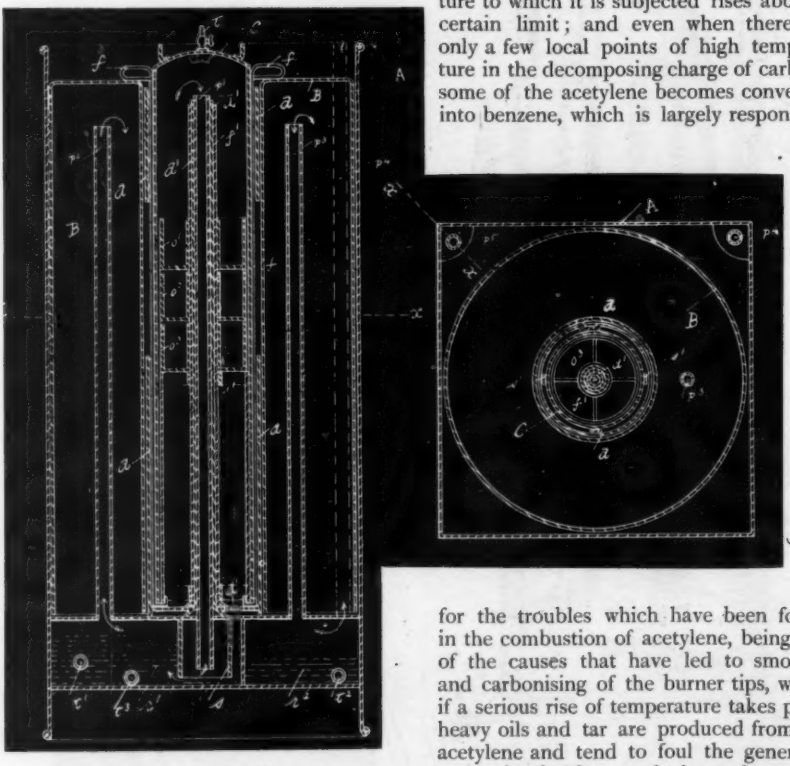


FIG. 40.—SECTIONAL DIAGRAM OF THE "ABINGDON" GENERATOR.

These troubles were at first of a very serious nature, but the generator makers having realised the causes which led to them have so modified their forms of apparatus as to reduce them to a minimum—subdivision of the bulk of carbide into a number of small charges being the best method of attaining this result. In some instances the generators are surrounded with water jackets, or are enclosed in the water of the holder; but although this reduces the general temperature and prevents overheating making itself apparent

by the temperature of the exterior of the generator, it does but little to prevent local heating in the charge.

These facts have been far more fully recognised in Germany than in this country, and with the rapid advance which acetylene lighting has made there the earlier forms of generator—which largely consisted of apparatus of the second subdivision, in which water drips on carbide, and the third subdivision, in which the carbide is dipped into water and is then withdrawn by the rising of the holder—have practically nearly died out, and by far the largest number of generators on the Continental market consist of those belonging to the second main division, in which carbide is thrown into water, the latter being always in excess.

The acetylene generated by this method has the advantage of being well washed, by its passage through the water in the generator, and to a great extent freed from ammonia and sulphuretted hydrogen, whilst the temperature to which the gas is subjected cannot rise above the boiling-point of water unless large lumps of carbide are employed. Under these conditions a skin of lime will sometimes form over the carbide, and overheating in the centre of the mass then takes place.

The worst that can be urged against this class of generator is that badly constructed forms of it give a smaller yield of gas from the carbide than is the case with the other types of generator, but this trouble can to a great extent be overcome by proper construction.

Vivian B Lewes

(*To be continued.*)

Modern Appliances in Gas Manufacture.

By G. E. STEVENSON, M.I.C.E.

G. E. Stevenson, eldest son of the late G. W. Stevenson, Consulting Gas Engineer, Westminster, was born in Cincinnati, U.S., served his pupilship at the London and Brighton Railway Works, and has been a Gas Engineer and a Manager of Gas undertakings for upwards of 25 years. He resided for six years (1885 to 1891) in the City of Buenos Ayres, South America, during which period he constructed the works of the River Plate Gas Company in Buenos Ayres; also the Gasworks at La Plata, and that at Paraná, in the Argentine Republic. Since 1891 he has occupied the position of Chief Constructing Engineer to the Gas Department of the Manchester Corporation. He is a Member of the Institution of Civil Engineers, and was President of the Incorporated Institution of Gas Engineers last year.

PART I.—STOKING MACHINERY.

The manufacture of coal gas dates from the beginning of the century; but its development on a large scale commenced in the fifties, and has continued at an increasing rate up to the present time notwithstanding the competition of electric lighting in recent years. In the earlier years of gas lighting, when the huge gasworks that now exist in the metropolis and in the leading provincial towns were undreamt of, the work involved in distilling the coal used for gas making was carried on entirely by hand, the retorts being charged either with a shovel or by means of a hand scoop and the residual coke withdrawn by the men with a hand rake. In small gasworks these methods still remain in use, but in almost all the gasworks of any importance in the United Kingdom this work is now performed by machinery specially devised for the purpose. Not only is the actual charging and discharging of the retorts done by machines, but many other operations incident to the manufacture of gas are performed mechanically, such as the storage of coal and coke and the moving of the large masses of purifying material required in the process of manufacture.

Many attempts were made to construct machines to do the work of the gas stoker before anything like success was attained. The first machine made for this purpose was devised by Mr. Henry Green, of Preston, in 1860. From that date onwards various types of stoking machines were introduced by different engineers. Up to 1875, however, no mechanical stoker previously designed can be said to have been successful, or to have continued permanently in use. Most of the earlier machines were actuated by steam power, the engine and boiler being in some cases fixed on the framework of the machine

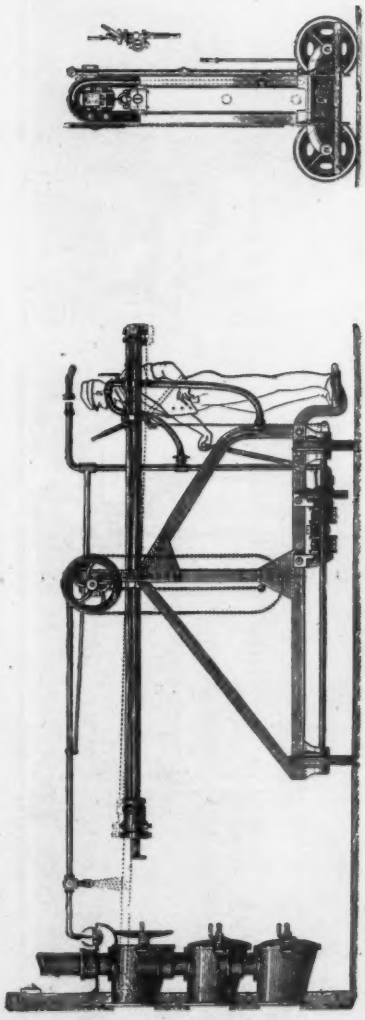


FIG. 1.—FOULIS-WOODWARD HYDRAULIC DRAWING MACHINE.

and travelling with it; in other cases, the power was transmitted through line shafting and gearing.

FOULIS-WOODWARD HYDRAULIC STOKING MACHINE.

In the year 1875 Mr. William Foulis, the Gas Engineer to the Glasgow Corporation, brought out a stoking machine actuated by hydraulic power. The water pressure employed was low, being only 120 lbs. per square inch. The machine was tried at Glasgow, but was not permanently adopted there. A set of machines (Figs. 1 and 2) was, however, made at Manchester by Messrs. Adam Woodward & Sons, and put to work at the Rochdale Road Station of the Manchester Corporation Gasworks. The machine for charging the retorts consisted of a cast-iron frame, on which a pair of hydraulic rams were mounted and connected with a vertical shaft carrying a drum. Round the drum a chain was wound, the ends of which were connected to a scoop carriage travelling on a beam. The drum shaft was revolved by the movement of the rams in opposite directions, the rams having racks attached to them which geared with a pinion on a cross shaft, and from this cross shaft the motion was communicated to the drum shaft by bevel wheels. Supplementary rams actuated a pair of cranes, by which the scoop, laden with coal, was lifted and placed in position in front of the scoop-carriage. On setting the rams in motion the scoop was driven into the retort, and withdrawn therefrom after discharging its contents. The deposition of the coal in the retort was accomplished by giving the scoop a half turn at the end of the stroke, so that the coal fell from the inverted scoop into the retort, the scoop returning upside down and righting itself at the end of the return stroke. These movements were effected by setting the head-stock of the scoop in a loose collar on the carriage. The ends of the chain were passed half round the head-stock, and as the end of the stroke was reached the chain became taut and pulled the head-stock and scoop round half a circle. The discharging or drawing machine consisted of a malleable iron tube (afterwards replaced by one of drawn steel), in which a piston and rod

worked. At the end of the rod was fixed the rake head. The whole was supported on a triangular frame mounted on wheels, and provided with a hand wheel and gearing for travelling on rails laid down on the retort-house floor. Suitable reversing valves were provided for both machines, worked by levers for controlling the movements of the rams. The hydraulic pressure supply was obtained from an accumulator, and conducted to the machines through "pendulum" pipes attached by swivel joints to a pressure main fixed overhead on the retort-house wall.

In general outlines may be thus described the first hydraulic stoking machines. They lacked one essential feature, viz., a means of mechanically conveying the coal to the charging machine. Nevertheless, they were used in Manchester and Salford for many years, and contributed in a marked degree to the economical production of gas. In subsequent machines of a similar type Messrs. Woodward & Sons added some important improvements. They designed and constructed a coal conveyor to bring the coal to the charging machine. In conjunction with the coal conveyor is fixed a large hopper, into which the railway coal wagons are emptied. At the bottom of the hopper is a breaker for breaking the coal and cannel into small lumps. From the breaker the coal falls into a pit, from whence it is elevated and placed in position for the buckets of the conveyor to receive it. The attention of a man to fill the buckets is required, after which the coal needs no further handling. On the top of the charging machine is fixed a hopper, which receives the coal from the conveyor, and from this hopper the coal descends into the scoop, this action taking place when the machine man revolves a hand wheel on a shaft carrying blades fixed under the bottom of the hopper. The charging machine is also provided with automatic travelling gear, consisting of a pair of rams fixed horizontally and connected by a rack which gears with a pinion, and through this pinion to the axle of the machine by bevel gearing. A clutch arrangement allows the rams to be reversed without moving the machine backwards.

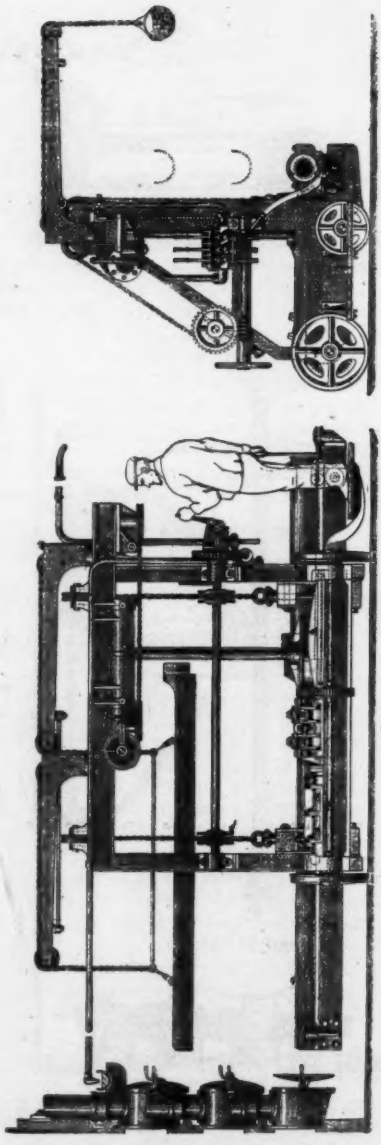


FIG. 2.—FOULIS-WOODWARD HYDRAULIC CHARGING MACHINE

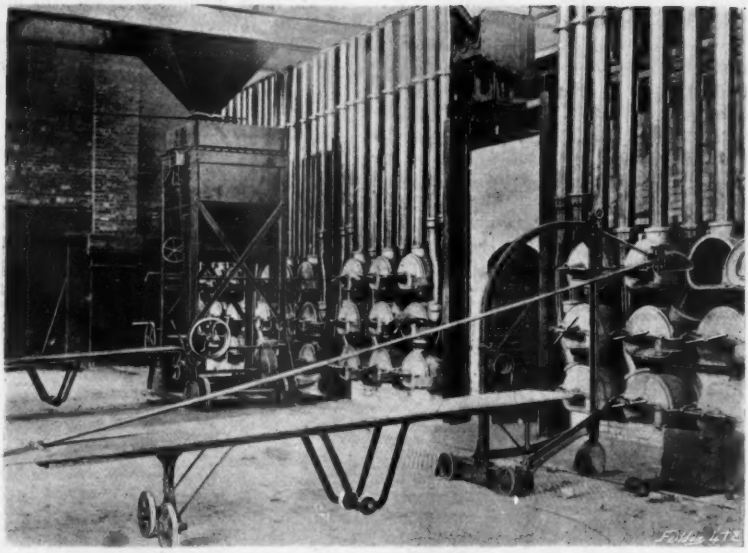


FIG. 3.—WEST'S MANUAL STOKING MACHINERY: DRAWING AND CHARGING MACHINES.

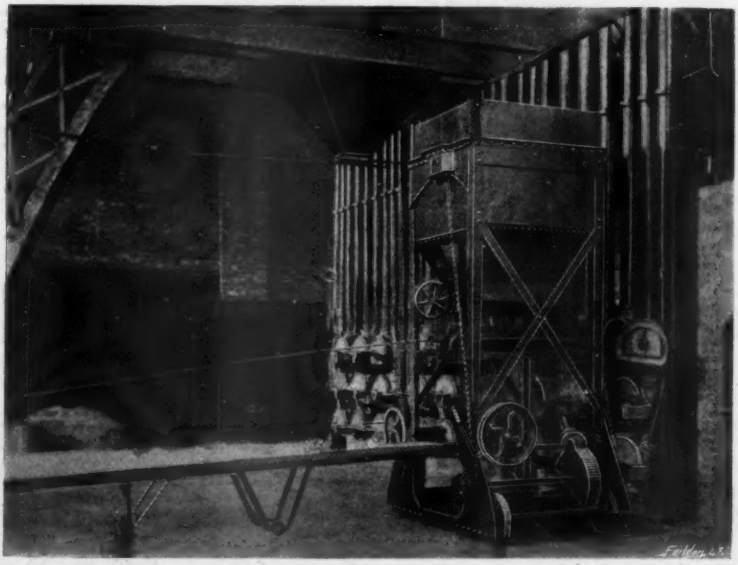


FIG. 4.—WEST'S MANUAL STOKING MACHINERY: CHARGING MACHINE.

Although these machines cannot with exactitude be termed "modern appliances," they form the groundwork of modern stoking machinery, and practically embody all the ideas which in later types of machines have been somewhat differently worked out. The Foulis-Woodward machines are still in use at two of the Manchester Gasworks and at the Salford Gasworks.

WEST'S MANUAL AND PNEUMATIC STOKING MACHINE.

The next successful attempt to cope with the difficulties of mechanical gas stoking was made by Mr. John West, who, when occupying the position of Engineer to the Maidstone Gas Co., designed and patented what is known as the West Manual Stoking Machine. This machine (Figs. 3 and 4) was designed to meet the requirements of the smaller gasworks. While still actuated by hand, it made stoking a much easier operation, and combined with it was the most important feature of modern stoking machinery, viz., the coal breaker and elevator.

In the West Manual Machine, the coal, after being broken and elevated into an overhead hopper, is introduced into the retort by means of a trolley-carriage, which is run into the retort by hand. The trolley-carriage consists of a light frame, on which are fixed two short scoops side by side. The scoops are pivoted on axles, so connected by gear wheels that by the movement of a lever at the end of a central rod the scoops are made to revolve on their axles in opposite directions and deposit the coal in the retort. The trolley-carriage is mounted on small wheels, which run on the floor of the retort. The carriage is introduced twice into the retort, the first time depositing the coal at the back half of the retort, and then, after being refilled, charging the front half.

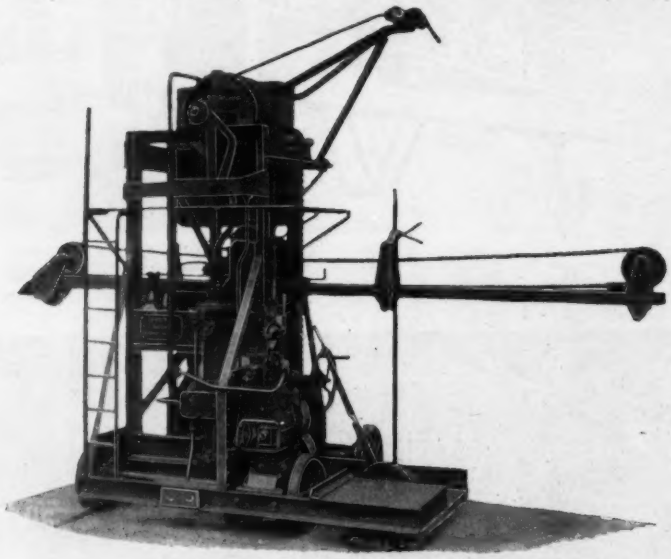


FIG. 5.—WEST'S PNEUMATIC DRAWING MACHINE.

The drawing machine is a rake—balanced between pulleys on a suspended bracket, and thrust into and withdrawn from the retort by hand, the weight of the rake being supported by the pulleys.

From the manual machine to a similar machine actuated by power was an easy

transition. In 1880 Mr. West became Gas Engineer to the Manchester Corporation. At Manchester the hydraulic machines were already in use. Mr. West quickly transformed his manual machines into machines worked by compressed air. The trolley carriage was retained, and only such modifications of the machines took place as were necessitated by the application of power. The manner of supplying power is as follows: Air is compressed in a compressing engine to a pressure of 60 lbs. per square inch and stored in cylinders fixed over the retort bench, with the object of preventing a reduction of temperature and pressure as the air is released. The compressed air is communicated to the machines through strong indiarubber tubes wound on drums, the pull of the tubes being counterbalanced by weights, so that the drums automatically unwind or wind up the tubes as the machines travel from or towards the position where the drums are suspended overhead. Cylinders with reciprocating pistons are used for actuating the machines, and the motion is communicated to the charger and to the rake by means of multiplying chain pulleys.

Since the first pneumatic machines were made they have undergone very considerable modification. The present type of West's Compressed Air Stoking Machine (Figs. 5 and 6) shows a great advance on all earlier attempts at mechanical stoking in gasworks. The framework of the machine is built up of steel. The charging machine carries a hopper capable of containing from 4 to 6 tons of coal. The hopper, together with a massive beam of steel, on which the charger travels and to which the air cylinders are attached, is raised or lowered by a pneumatic motor. The motor is also utilised for the automatic travelling of the machine on the rails in front of the retort bench. There are three air cylinders, the larger and central one being for pushing the charger into the retorts, and the two smaller ones for cushioning at the end of the stroke. The charging carriage to which the scoop is attached is sufficiently heavy and strong

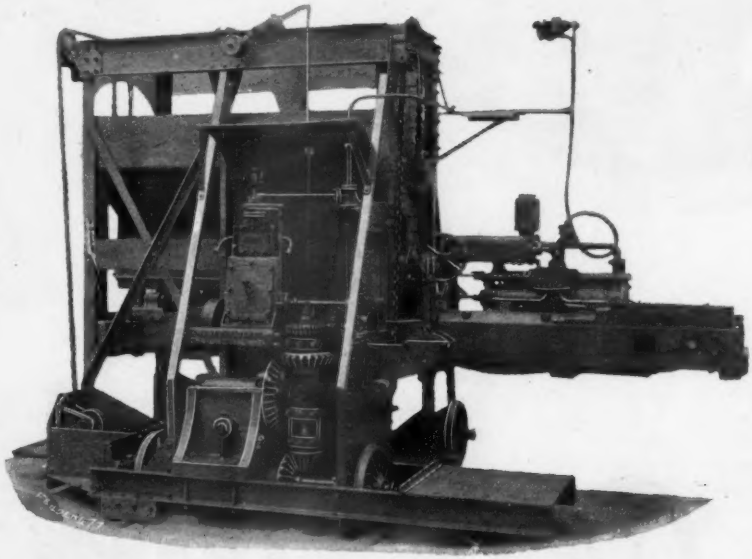


FIG. 6.—WEST'S PNEUMATIC CHARGING MACHINE.

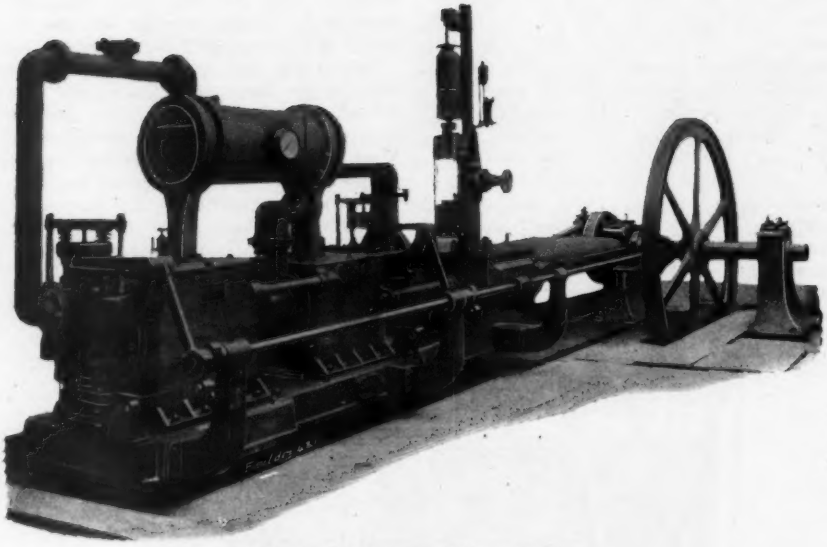


FIG. 7.—WEST'S SINGLE AIR-COMPRESSING ENGINE.

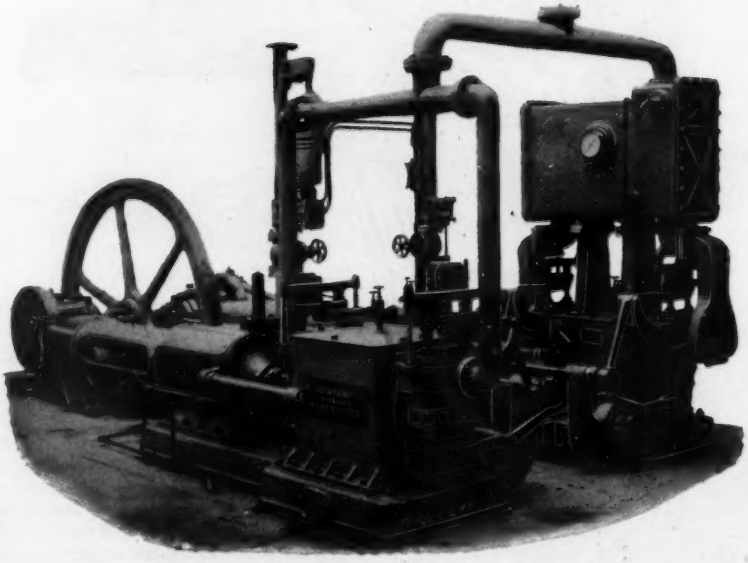


FIG. 8.—WEST'S DOUBLE AIR-COMPRESSING ENGINE.

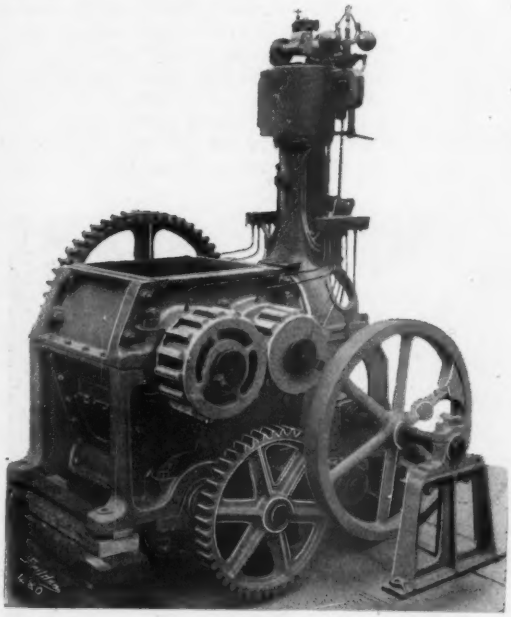


FIG. 9.—WEST'S COAL AND CANNEL BREAKER.

to support the weight of the scoop and its charge entirely, the end of the scoop hanging free. An ingenious arrangement is included in the carriage, by which the headstock of the scoop may be turned round either to right or left when depositing the charge in the retort. The scoop is somewhat smaller than that used on the Foulis-Woodward machine, and is introduced twice into the retort, being turned over first one way and then the other, so as to deposit the coal towards each side of the retort. The drawing machine is still usually travelled by hand, but the largest machines are provided with motors. The rake is carried on a beam, which can be raised or lowered as desired. It is actuated by a piston working in a cylinder placed vertically, and the motion is communicated by means of a chain passing round multiplying pulleys. Both the rake and the charger work at a much higher speed than was adopted for the earlier hydraulic machines, and the retorts can be drawn and charged at an average rate of 45 seconds each. Figs. 7 and 8 are illustrations of the most modern type of air-compressing engine, and Figs. 9 and 10 are coal and cannel breakers as adopted for West's machines.

FOULIS-ARROL HYDRAULIC STOKING MACHINE.

The latest style of stoking machine is one designed by Mr. Foulis with the assistance of Sir William Arrol. In this new type of machine hydraulic pressure is retained as the motive power, but the machine differs essentially in several particulars from the hydraulic machines originally brought out by Mr. Foulis. In the first place, the pressure is increased to 350 lbs. per square inch, and the rams being smaller the machines are of a lighter character. Wire ropes are used instead of chains for communicating motion from the rams to the reciprocating parts. The principal change, however, is in the method of charging the retorts. The scoop is abandoned in favour of a "pusher," the coal being no longer conveyed into the retort in a receptacle but dynamically thrust into the retort by means of the pusher. The charging machine has two hydraulic cylinders attached horizontally to a beam, one, the larger of the two, being for pushing in the charge of coal, and the other, of a smaller diameter, for withdrawing the pusher. The coal is carried in a hopper fixed on the top of the framework of the machine, and it is allowed to descend on to a plate, or shoot, one end of which rests on the mouthpiece of the retort, and from which it is pushed into the retort by the pusher. The quantity of coal descending on to the shoot is regulated by a revolving drum or paddle-wheel, which is divided up into several compartments by radial diaphragms. Each compartment holds 50 lbs. of coal. The wheel is rotated

by a hydraulic cylinder having a rack arrangement actuating the shaft of the wheel. At each stroke of this rack the wheel rotates just so far as to bring one of the compartments in an inverted position over the shoot; the contents then fall on the shoot, and are immediately pushed into the retort. As the total charge required to fill the retort is 3 or 3½ cwts. of coal, the operation has to be performed six or seven times, and in order that the coal may be evenly deposited along the length of the retort, and not heaped up at the back of it, it is necessary that the stroke of the ram actuating the pusher should be shorter at each succeeding stroke. This is effected by a stopper rod, on which is a series of collars. The rod is slightly rotated by gearing after each stroke, and the collars brought successively into action to reverse the valves at the proper moment and arrest the forward motion of the pusher. The raising and lowering of the beam is done by the direct action of a vertical ram, the beam being supported by wire ropes passing over sheaves at the top of the framing and connected to the inverted head of the ram. The charging machine is also provided with a hydraulic motor for automatic travelling movements.

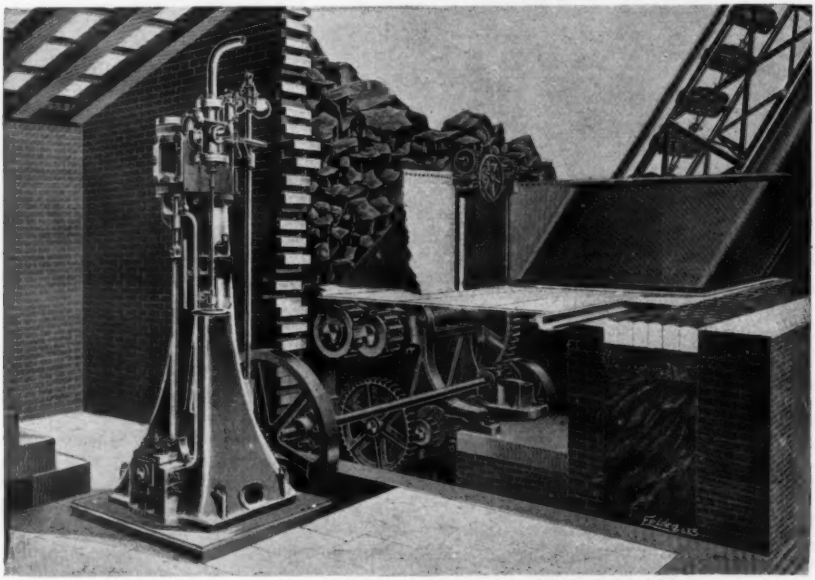


FIG. 10.—COAL AND CANNEL BREAKER, WITH ENGINE AND ELEVATOR.

C. E. Stevenson

(To be continued.)

The Building of a Great Railway.

The Great Central Extension to London.

(*Continued from page* 365.)

❀ ❀ ❀

At 22 miles 53 chains the Midland Railway main line is crossed by a girder bridge, a view of which is illustrated. It consists of four spans of 40 ft. each in length, with plate girders, lattice parapet, and flat flooring, the total weight of materials being 197 tons.

This is followed by two small-span plate girder bridges at 22 miles 56 chains and 22 miles 57 chains. A few chains farther south, the Loughborough and Leicester canal is crossed by a steel plate-girder bridge with lattice parapets, with a skew span of 48 ft. The foundations of this structure were very deep and costly.

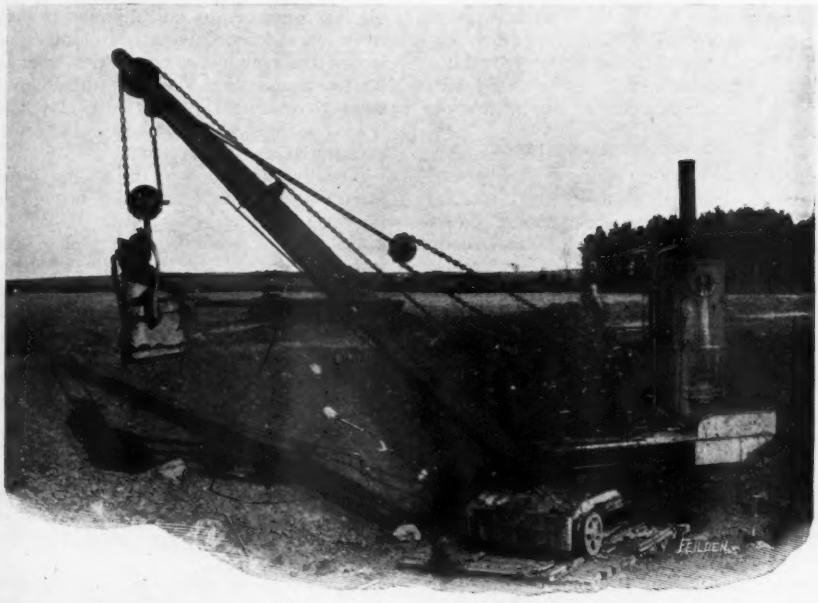
Loughborough Station is reached after passing over a public road at 23 miles 6 chains by a 3-span plate-girder bridge with brick parapets. It has an island platform, 500 ft. in length, reached by a staircase from the road, which is on the high level. The road crosses the railway by a heavy girder 2-span bridge with brick arches and steel main girders. There are the usual offices, waiting rooms, warehouses, sidings, and all the appurtenances of a station serving an important district. The platform is covered with roof-work extending 218 ft. The waiting-room buildings, which stand on the centre of the platform, are 15 ft. outside of walls. This leaves 15 ft. clear from the face of the wall to the nose of the platform, both on the up and down lines.

The roof-work is carried on sixteen steel lattice cantilevers, spaced 14 ft. 6 in. centres, thirteen of which rest on the building, whilst the other three are supported on six ornamental cast-iron columns. The top of the cantilevers, which are level between the buildings but rise about 1 in. towards each end, is about 13 ft. above the platform level. The ends of the cantilevers are 7 in. deep and gradually deepen towards the building, where they

BRIDGE OVER THE MIDLAND RAILWAY AT LOUGHBOROUGH.

are haunched down to a depth of 3 ft. This part of the cantilever is made lattice, the top flange being made of two angles. The bottom flange is of similar construction. The flange plate starts about 7 ft. from the end and tapers from 8 in. to 12 in. at the bearing, the lattices being of steel channels. Between the buildings the cantilevers are haunched up and run a parallel depth of 15 in., the section at this part being two angles, $3\frac{1}{2}$ in. by $3\frac{1}{2}$ in. by $\frac{1}{2}$ in. top and bottom, and a $\frac{12}{32}$ in. web plate, stiffened with 6 in. by 3 in. by $\frac{1}{2}$ in. tees. The cast-iron columns which support the cantilevers beyond the buildings are 12 ft. 6 in. long, the part at platform level being octagon shape, $10\frac{1}{2}$ in. across the flats. Just above this the column is $7\frac{1}{2}$ in. diameter, and fluted, then again returns to the octagon shape, 7 in. across the flats, and gradually tapers to 6 in., and finishes off with an ornamental head. The cantilevers over the cast-iron columns are the same excepting that part between the columns, which is latticed instead of web plated, and gradually haunched up to the centre to match the outer portion. Along the ends of the cantilevers runs a facia lattice girder, 12 in. deep, to which the facia boarding is attached, and also carries the cast-iron guttering. The steel tee principals are supported by the cantilevers, and on them rest the cast-iron ridges and hips. The facia gutter joins up to a valley gutter, which is a moulded section and runs along the top of each cantilever, and then joins the wall gutter in which are outlets which drop into ornamental fountain heads attached to the down pipes. The buildings are divided into two blocks, thus providing an opening between the platforms to carry the wall and copings. Two trough-shaped cast-iron girders are fixed, these being panelled on either side, and underneath cast-iron spandrils of a floral description are bolted, which give a very artistic appearance to the steel principals

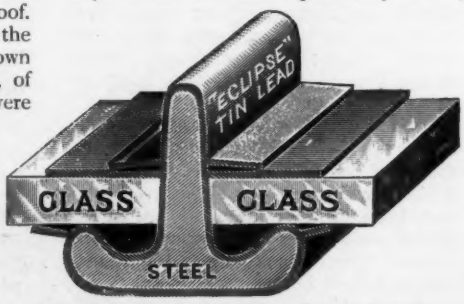
LOUGHBOROUGH STATION.



ONE OF THE EXCAVATORS SUPPLIED BY MESSRS. J. H. WILSON AND CO., LTD., SANDHILLS, LIVERPOOL.

and cantilevers. At the south end of the station a staircase leads up to the booking-hall, in which are fixed two lattice girders, the ends of which project through the wall 12 ft. and form a support for the cab awning roof. On either side of the two projecting girders are fixed two short lattice girders, one end resting on a cast-iron column similar in design to those used on the platform level. Steel principals, cast-iron ridges, and cast-iron gutters are used similar to the station roof. The steel work in connection with the above was executed by the well-known firm of E. C. and J. Keay, Limited, of James Bridge Works, Darlaston, who were also responsible for much of the constructional work in the Leicester goods yard buildings, &c.

The roof glazing is on Mellowes & Co.'s patent "Eclipse" system. The glazing contract, which is certainly the largest ever given to one firm, as it practically means the glazing of every station on the railway, was carried out by Messrs. Mellowes & Co. of Sheffield. The speciality of this system consists in the fact that the steel bars supporting the glass are of the best rolled steel, entirely covered in one piece with a patented tin-lead metal. At the top of the glass is a double flange which entirely prevents any dust or wet getting through, whilst underneath there is a third flange which renders the bar imperishable and drop dry. There is also no possibility of rust,



SECTIONAL VIEW OF A GLAZING BAR: MELLOWES' SYSTEM.

as no portion of the steel bar is exposed to the atmosphere, and the outer covering of tin-lead metal has successfully resisted atmospheric influence during a trial lasting over seventeen years. Our illustration of

LOUGHBOROUGH STATION

gives a very good idea of the general appearance of the roofing and glazing, while the illustration on page 465 gives a detailed sectional view of the glazing bar.

The passenger and goods stations at Loughborough are close to each other, and whilst ample facilities are provided for a large traffic, the exigencies of the future have not been lost sight of, as a very large space has been reserved for future extensions.

Leaving Loughborough Station, the line passes under Beeches Lane—which is carried over by a 40-ft. girder bridge—a small occupation bridge; a small span bridge carrying over Woodthorpe Lane until, at 24 miles 27 chains, a heavy skew girder bridge is reached, which carries the Leicester Road over the railway. The main girders of this bridge are 70 ft. long by 7 ft. deep. Although weighing 18 tons each, they were brought to the site in one piece and lifted with a derrick.

Continuing south, three small cuttings are passed in succession, representing between them 150,000 cubic yards of excavation. One of these must be mentioned in particular, in that the wet necessitated the construction of rubble drains with arches in nearly every 20 ft. At 25 miles 2 chains, two small occupation bridges are passed, and a small cutting contains the Quorn and Woodhouse Station, Quorn; the village which it serves being noted in its connection with the Quorn hunt. Woodhouse lies on the opposite side of the line to the eastward.

This station possesses the usual characteristics of the smaller stations, except that the platform is reached from the road bridge by a staircase. Extensive sidings have been provided, and it is anticipated that an extensive passenger traffic will be centred here, on account of the vicinity of Charnwood Forest.

Skirting the Charnwood Forest Hills, the line runs on an embankment responsible for 100,000 cubic yards of material, intersected only by two occupation bridges. At the termination the line immediately enters a cutting through hard clay and boulders, from which 70,000 cubic yards of material were excavated.

The illustration on p. 465 shows one of the excavators which were used throughout the line, made by Messrs. John H. Wilson & Co., Ltd., of Sandhills, Liverpool. These machines differ from the ordinary steam navvy in that there is no limit in revolving, the machine being able to rotate in an entire circle, and is, therefore, not restricted to any fixed position for delivering the excavated material. In the event of slips in a cutting, the advantage of being able to cut their own way out by wheeling round will become at once apparent. A 12-ton machine, fitted with a 1½-yd. bucket will excavate and deliver into wagons from 800 to 1,200 cubic yards per day of 11 hours, according to the nature of the ground.

At 26 miles 39 chains an aqueduct consisting of a steel trough, well protected with tan to resist the influences of frost, carries the water mains of the Leicester Corporation over the line.

Immediately following are the Swithland Viaducts of five and ten spans respectively, with a plate-girder bridge of 40 ft. span, carrying the rails over the Swithland reservoir. The bank is pitched to within 2 ft. of the water level with 12-inch pitching.

Passing one or two occupation bridges and a steel bridge over the public road, Swithland Sidings are reached, where a goods station has been provided and an excursion platform is to be constructed. The former are used for the cattle and granite traffic. From these sidings a single branch line, 2 miles in length, of standard gauge, to the Mountsorrel quarries, has been constructed.

This is the only district in the Midlands where granite is obtainable, and several large quarries are being worked from which large quantities of paving-stone, road material, &c., are sent to various parts of the country.

Continuing southwards, the line enters

another cutting through marl and sand, from which 100,000 cubic yards of material were removed. At the termination is situated Rothley Station, which is of the ordinary type, the island platform being approached from a two-arched bridge carrying the road. Leaving the station the line enters on an embankment, which entailed some very heavy work, 180,000 cubic yards of earthwork being requisitioned. The embankment is divided by a stream and an occupation road, the line being carried over by a brick tunnel bridge of 40 ft. span. The stream had to be diverted, and side walls built up, in consequence of the floods which prevail during the rainy periods. Piles also had to be driven at the foot of the bank slopes, and the roadway covered with a layer of concrete.

From this point the line enters a cutting of tough boulder clay, from which 50,000 cubic yards were taken. This proved the hardest piece of cutting work on the section.

The first section of the contract terminates at this point. Both first and second sections are under the charge of a Resident Engineer, Mr. Geo. B. Chalcraft, A.M.I.C.E., whose portrait we now give. Mr. Chalcraft has had experience in a similar capacity on the Ripley and Heanor Branches of the Midland Railway, and acted as a contractor's engineer until 1893, when he was appointed under Mr. Edward Parry in charge of the Leicester portion of the contract.

Mr. F. D. Sharp, A.M.I.C.E., acted as Resident Engineer on the Loughborough section from 1894 to December 1896, and Mr. J. H. Ashworth from that date until July 1898, after which the whole of the contract came under the supervision of Mr. Chalcraft.

The second section, which commences in Thurcaston parish, extends for a distance of seven miles, more than four of which are within the borough of Leicester. As in the case of Nottingham, the works were of an exceptionally heavy character; except that in this case they were all on the high level. Leaving the 29 miles mark the line enters a cutting through Birstall Hill, 1¼ miles in length with a depth culminating at 43 ft. The

MR. GEORGE B. CHALCRAFT, A.M.I.C.E., RESIDENT ENGINEER OF NO. 2 CONTRACT.

excavations consisting of a hard glacial lias boulder clay, sand, and gravel amounted to 370,000 cubic yards. A short distance to the south of this cutting is Birstall station, which will form the ticket collecting platform for Leicester.

The usual island platform is reached from a bridge over the cutting, carrying a new road connecting in turn with the main road.

A bank of 160,000 yards of earthwork is next reached, crossing at its deepest part by a heavy arched bridge, 80 ft. 7 in. in length, with skew and square spans, the Thurcaston Road. The span on the skew is 48 ft. 10 in., while that on the square is 40 ft. At the face of the arch the courses are laid at right angles to the heading spirals, and in the centre parallel to the abutments with intermediate curved portions. This arch is typical of the general principle on which the other arches on the Leicester section —nine in all—are constructed.

At Abbey Lane, 32 miles, are laid down a number of sidings for dealing with the coal traffic of the district which is rapidly assuming increased proportions. Half a mile further south the line enters the town of Leicester, by a viaduct commencing at Harrison Street—which is spanned by a 40-ft. plate-girder and parapet bridge—and extending for more than a mile over some of the principal thoroughfares.

Generally speaking, the line here is carried upon brick arches, connecting which are a number of steel bridges, some of very important dimensions, spanning the main streets, above the level of which the rails are pitched at an average height of 20 ft.

The head-room, generally speaking, has been insufficient to permit the use of brick arches over the roadways. The brick portion consists generally of arches with spans averaging approximately 30 ft.

The centre pier was constructed within a coffer-dam of single-sheet piling.

Passing a plate-girder bridge of 40 ft. span, carrying the line over Slater Street, the Leicester Canal is reached at 32 miles 72 chains. This is spanned by a fish-belly type bridge of plate girders, each 80 ft. long and weighing 23 tons each. Each girder was delivered to site riveted in one length and carried on the abutments with trollies. Two 14-ft. timbers trussed with tie-rods were thrown across

MOWMACRE BRIDGE (31 MILES 15 CHAINS) FROM THE EAST.

The first of the series of large span bridges is that over Abbey Lane (32 miles 53 chains). It consists of plate main girders 78 ft. long by 9 ft. 6 in. deep, weighing 29 tons each. They were conveyed from the Horseley Company's works to the site in two pieces, lifted with a derrick, and jointed on a trestle. The river Soar is crossed at 32 miles 58 chains by a bridge of two spans, each 84 ft. in length. There are four lattice girders to each span 89 ft. 1 in. long and 9 ft. deep.

the canal to avoid using piles. An illustration shows the first girder being carried into position over the trussed stage. The fish-belly type was adopted in this case to obtain the necessary head-room for the roadway adjoining the towing-path and running parallel to the canal.

At 32 miles 79 chains Northgate Street is spanned by a very sharp skew bridge. The large main girder is 138 ft. long, 17 ft. 3 in. deep at the centre, and weighs 81 tons. The small main girders are

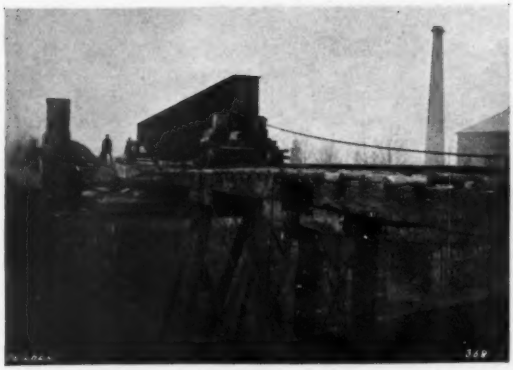
BRIDGE OVER THE RIVER SOAR AT ABBEY MEADOWS (32 MILES 58 CHAINS), FROM THE WEST.

129 ft. long, 17 ft. 3 in. deep at centre, and weigh 72 tons each. The bridge is fan-shaped in plan, as the line here commences to open out for Leicester Station.

In erecting trestles for the staging, two sets of rails had to be contended with. Some difficulty was experienced in erecting this bridge, owing to the extreme angle at which it crosses the road. An illustration shows a view of the Horseley Company's yard, with the Northgate Street Bridge in course of construction. The 61 steel bridges on this contract were entrusted to Messrs. the Horseley Company, Ltd., of Tipton, Staffs, who, taking into consideration the difficult nature of the work, the heavy weights dealt with, the busy streets of Leicester over which bridges had to be erected, and the fact that not a single life was lost, nor did any serious accident occur either to workmen or public, have created a distinctly magnificent record. We take this opportunity of thanking Mr. T. Hughes, the Secretary, on behalf of the Company, for the drawings, photographs, and details which have been so courteously placed at our disposal.

Leicester Passenger Station, a general view and plan of which are given in the accompanying illustrations, is upon a high level, and consists of an island platform 1,240 ft. long by 80 ft. wide, with a bay at each end for the accommodation of local trains. The platform is approached from the street level by flights of York stone steps

VIEW OF THE HORSELEY COMPANY'S YARD, SHOWING NORTHGATE STREET BRIDGE IN COURSE OF CONSTRUCTION.



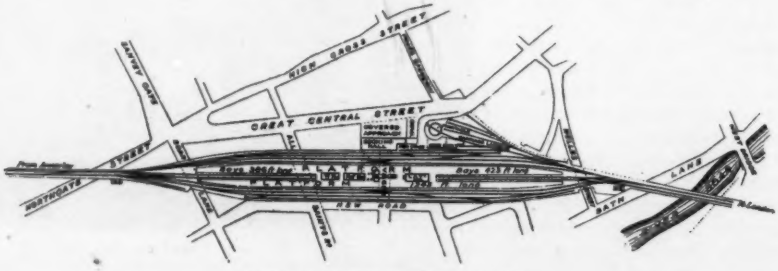
BRIDGE OVER CANAL, NORTHGATE, LEICESTER, SHOWING THE FIRST GIRDER BEING CARRIED INTO POSITION OVER TRUSSED STAGE.

from subways leading from the booking-office. This is in the centre of the station, on a level with the new 50 ft. street formed by the Company leading into St. Nicholas Street, which has been widened. By this means, easy and convenient access is obtained to the market place situated in the centre of the town. The major portion of the station is under a glazed roof, supported on steel columns. Buildings have been erected centrally containing the usual offices, waiting, dining and refreshment rooms. The basements have been utilised for kitchen, cellar, store and office arrangements. The subways are lined with buff glazed bricks, while the buildings are faced with pressed red heather bricks and buff terra-cotta from Hathern.

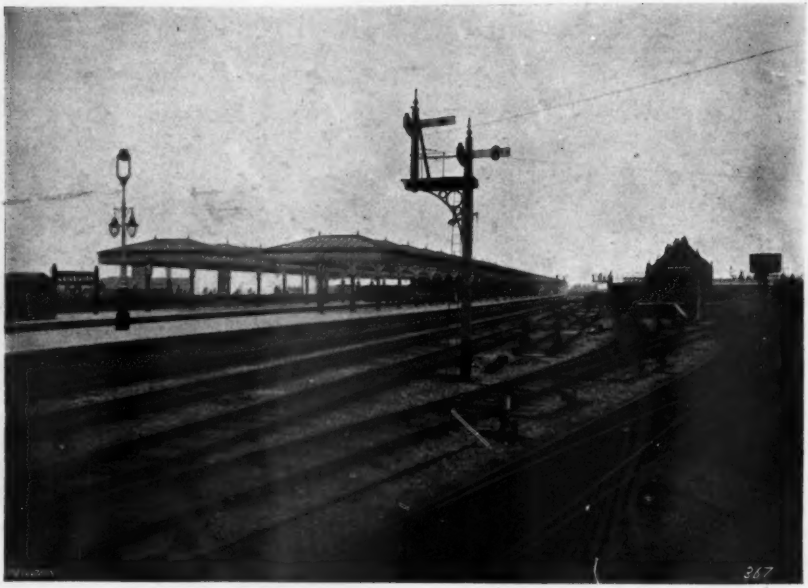
The three subways leading from the east side are bridged over with steel trough flooring. The spans are 8 ft. each and 51 ft. 3 in. in length. The three subways, after passing under the rails, lead into openings at the foot of the staircases leading up to the platform. These openings are spanned by six girders each 35 ft. long, 2 ft. 3 in. deep, and carry joist framing which in turn carry the platform footway lights. On either side of the lights between the girders curved steel floor plates are fixed and riveted, and on these concrete is laid, and then the platform flags. The floors of the various blocks of buildings on the platforms are supported on R.S. joists, between which are fixed rolled steel plates covered with concrete. Close to the subways at the platform level are fixed some joists and floor plates to allow the signal wires and rods to pass under to the signal cabins.

Under the southern end of the station is a celebrated Roman pavement, which has been carefully preserved, a convenient access having been formed to enable the public to view, as heretofore, this relic of ancient history.

As is the case at other places on the line, a large amount of property had to be acquired in Leicester not actually required for the railway, which now forms a valuable asset of the Company and is likely to appreciate very much in value in the future.



PLAN OF LEICESTER PASSENGER STATION.



GENERAL VIEW OF LEICESTER PASSENGER STATION FROM THE SOUTH-EAST.

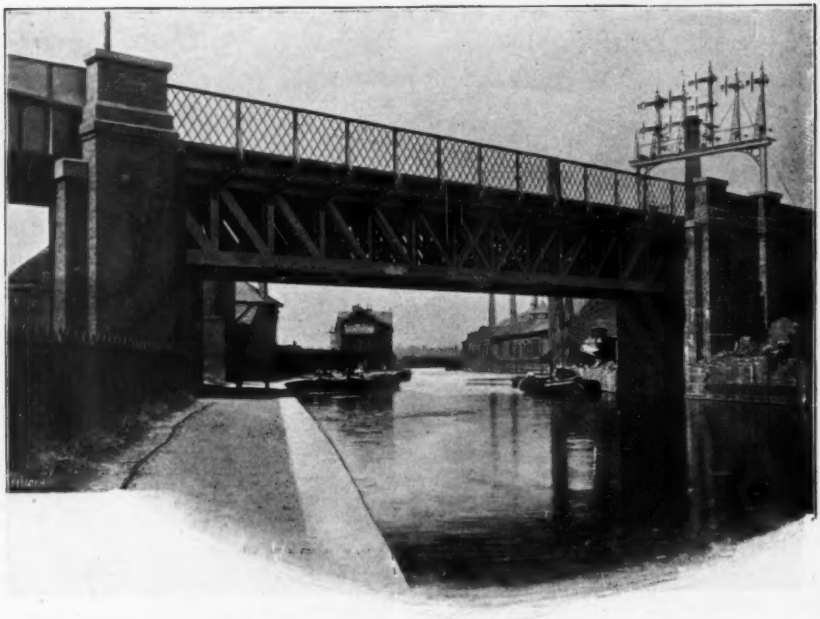
A large number of houses of the labouring-class type had to be demolished, but the Company have erected 300 new and substantial dwellings to replace these at Newfound Pool.

Reverting to the plan of the station, it will be seen that three roads penetrate beneath, viz., Soar Lane, All Saints' Road, and Wellis Street. The plate-girder bridge carrying the line above all has spans of not less than 40 feet.

Leaving the station, the lines converge to cross Bath Lane by a large plate-girder bridge with girders 88 ft. long 9 ft. 6 ins. deep, each weighing 34 tons, and which were carried across the staging in one length on a trolly, afterwards being jacked into position.

Immediately afterwards, at 33 miles 32 chains, the River Soar is encountered, which is crossed by a skew-deck bridge of single-span design. As seen from the general cross-section given on page 473, it consists of two pairs of main girders running parallel, each pair carrying a single track and being separated one from the other to a distance equivalent to the six-foot way.

A system of transverse bracing connects the lower chords of each pair of girders, while the upper booms are braced and a platform of steel plates, adding to the rigidity, forms a horizontal diaphragm and completes the connections. The main girders have a span of 104 ft. 8 ins., or a total length over the end pillars of 107 ft., and are 10 ft. 4 in. deep, each weighing 33 tons. They were delivered to the site in three sections, carried into position with a traveller and jointed on trestles fixed in the river. As is perceptible from the photograph, the web is made up of diagonal and horizontal members relatively fixed at an angle of 50 degrees, with a distance of 7 ft. 8 in. between the vertical members. Cross girders have not been adopted, the steel flooring plates being supported by T steels, which are in turn riveted to the horizontal plates of the upper flange of the main girders. These



BRIDGE OVER THE RIVER SOAR AT 33 MILES 32 CHAINS.

latter act as part of the flooring, thus saving some hundreds of feet of steel flooring plates. Both flooring plates and upper flanges of the main girders are covered with a layer of asphalte 1 in. thick. A footway carried on cantilevers, composed of steel plates, lattice bars, and angle sections, is provided on each side of the bridge at the level of the rails. The parapet consists of a trellis girder 104 ft. 3 in. in length by 6 ft. in depth. A reference to the diagram will shew that the cantilevers are carried upwards to form a support to the parapet.

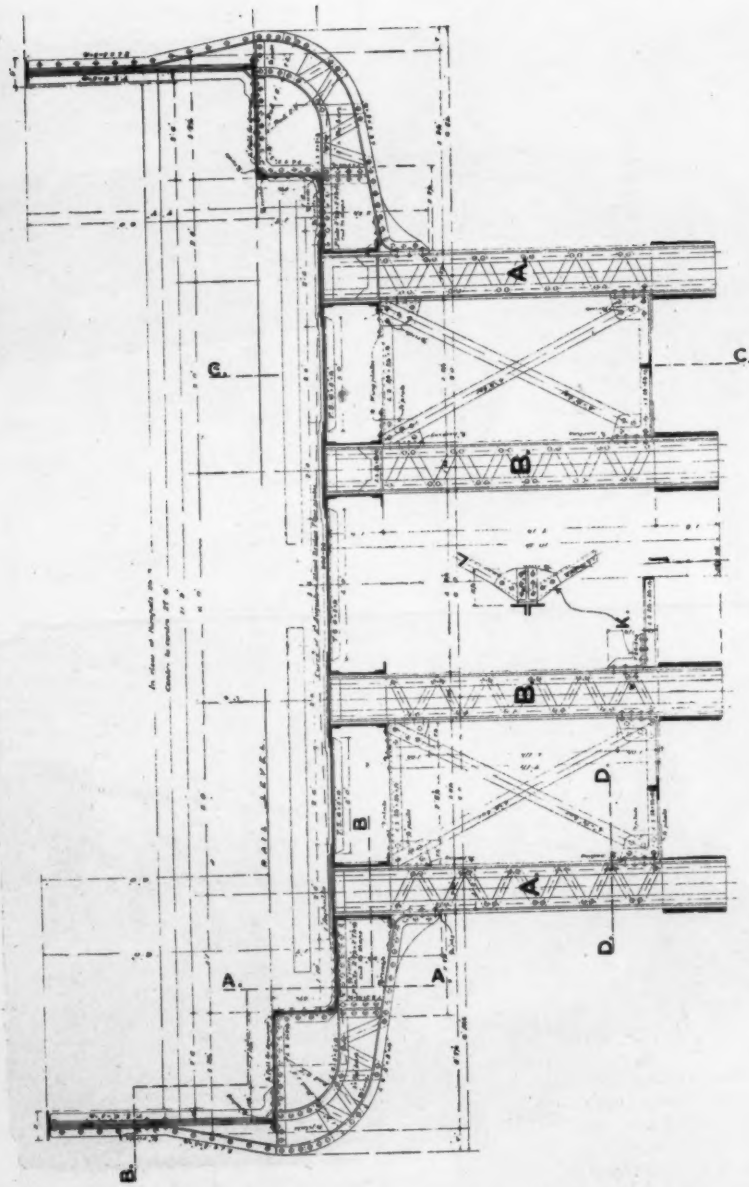
Altogether this bridge is an admirable type of up-to-date engineering practice, combining and exemplifying the most modern construction principles, at the same time preserving a due amount of elegance in design.

Fourteen chains further on the line crosses over Braunstone Gate, Leicester, by a lattice-girder skew-span bridge. The girders are very unequal, the larger being 178 ft. 3 in. long by 19 ft. deep at centre, and weighs 126 tons; while the smaller is 135 ft. long, is 19 ft. deep at centre, and weighs 72 tons.

These are the longest and heaviest main girders used on the section, and carry the railway over the River Soar and main road. A very large temporary stage had to be erected, and special precautions taken, to avoid putting any extra weight on the bridge below which carries the road over the River Soar.

The cross girders supporting the flooring are 8 ft. apart

The Old River Soar is encountered at 33 miles 52 chains, and is spanned by the heaviest bridge on the whole of the section. It consists of two pairs of main lattice girders of 129 ft. span, the total length being 152 ft., with a depth of 13 ft. 6 in. Each weighs 72 tons. In erecting, the River Soar was piled and a stage put up. The steelwork leaving the Horseley Co.'s Works was small, as



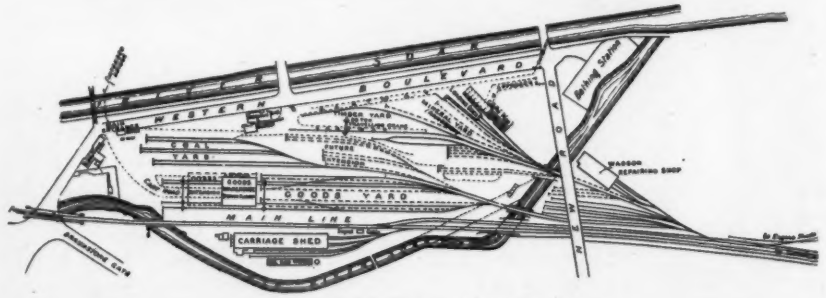
CROSS SECTION OF BRIDGE OVER THE RIVER SOAR AT 32 MILES 32 CHAINS.

BRAUNSTONE GATE BRIDGE, LEICESTER.

BRIDGE OVER THE OLD RIVER SOAR AT 33 MILES 52 CHAINS.

practically all the riveting had to be executed at the site.

The main line, after traversing this bridge, crosses the Leicester goods yard on an embankment. This yard is only a short distance from the passenger station, and is conveniently situated near the business parts of the town, especially now that the intended bridge marked on the plan has been constructed, giving access from the other side of the River Soar. The yard occupies what was formerly known as the Bedehouse Meadows, and comprises about 66 acres of land. The yard has been equipped in the most up-to-date manner with buildings, machinery, and plant necessary to deal with the traffic to and from a large town. Prominent to the left is the hand-



PLAN OF LEICESTER GOODS STATION.

some goods warehouse, a view of which is given. The internal dimensions are 150 ft. by 128 ft., but ample space has been reserved in view of any future enlargement to meet the requirements of a growing traffic. Platforms, cart bays and sidings occupy the ground floor, the two upper storeys being set aside for grain, etc.

The building is situated on the east side of the main lines. At the south end are two large openings for the entrance of the wagons. Over these at the first floor level are two large box girders to support the walls above. These girders are about 8 tons each, and one is 27 ft. span and the other is 24 ft. 9 in. These girders are supported on stanchions 22 ft. 7 in. long. The stanchions are box shape and made up of steel plates and angles with large bases to distribute the weight. At the south-west corner there is also another opening 11 ft. 3 in. in the clear, and on the east side there are three openings 15 ft. in the clear. Over each of these openings are box girders, all at the first-floor level.

The steel girder work inside is supported on columns which rest on huge bases. The columns are spaced at 21 ft. 7 in. centres from north to south, and from east to west they vary from 28 ft. 9 in. to 30 ft. 9 in. centres. From north to south are fixed between the columns what may be called the main girders, which in their turn support the cross girders. These girders are termed plate-web girders. The main girders are 20 ft. 8¾ in. long and 3 ft. deep between the angles, with flange plates 1 ft. 6 in. wide, and weigh about 3 tons each. There are 95 girders at this first-floor level, in addition to the 7 box girders. On the east side, at the first-floor level, there are cantilever girders attached to the cross girders. These project out 12 ft. beyond the brickwork, and when covered form an awning for the drays to stand under whilst loading or unloading. The flooring is composed of wood joists and boarding. The height from rail level to first-floor level is 26 ft. 2 in., and from first-floor to second-floor level is 13 ft. 7 in., and from second-floor level to underside of roof beams is 11 ft. The second floor is practically

LEICESTER GOODS WAREHOUSE, LOOKING NORTH-EAST.

the same as the first floor, the columns being continued from first to second-floor level, and thence to the roof, which is composed of wood principals with wrought iron straps and bolts.

Almost in the centre of the first and second floors one main girder and one cross girder are omitted. This leaves a wellhole about 60 ft. × 20 ft. for hoisting goods from one floor to another. The north end of the warehouse is so constructed that it may admit of any extension in the future, the columns and steel girders being fixed and for the present encased in brickwork which can be removed when required.

THE POWER HOUSE, LEICESTER GOODS YARD.

Hydraulic power has been requisitioned for the working of cranes, hoists, capstans, and turntables.

To the west of the main line and opposite to the goods warehouse is situated the carriage shed, which is provided with four roads.

This building is 400 ft. long and 69 ft. wide. The roof is made in two spans each 34 ft. 6 in., and the principals are spaced 10 ft. apart.

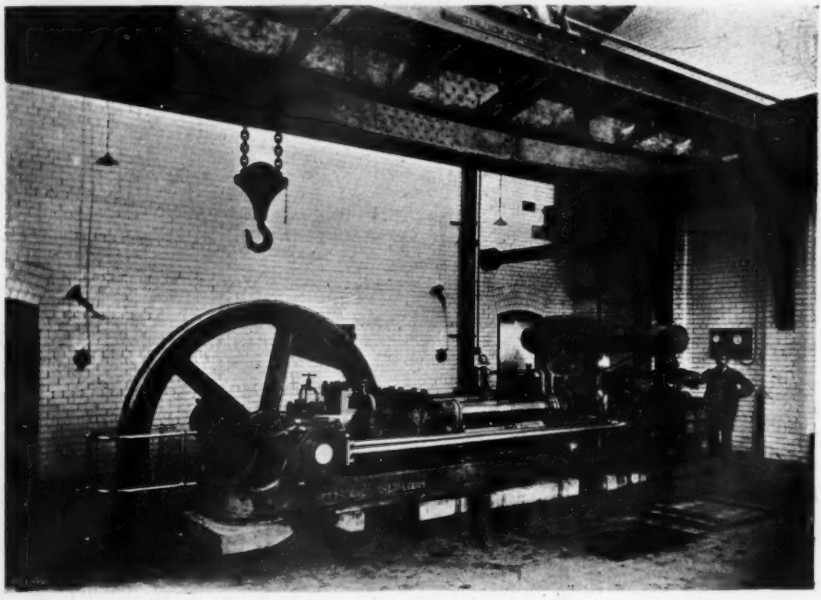
Along the centre of each span there runs a skylight 11 ft. wide in the clear, and under each span there runs two sets of rails, on either

side of which there are fixed in the floor troughs, which are supplied with water pipes, cocks, outlets, &c. These troughs are each 12 ft. long, 12 in. wide and 16 in. deep, with circular ends, and are covered with wood gratings when not in use for carriage-washing purposes. The top of the wood gratings are flush with the platform level, which is two feet above rail level.

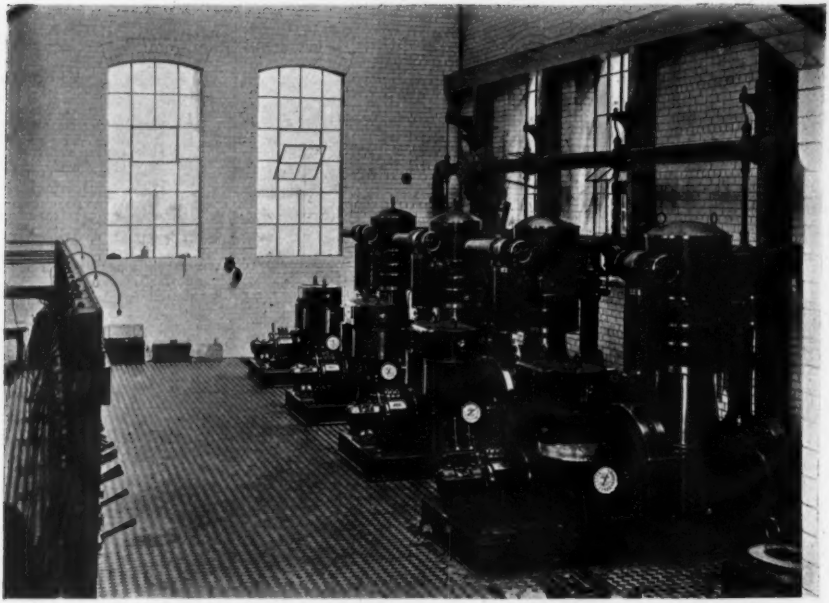
Close by are the Oil Gas Buildings, containing the plant for the generation of oil gas on Messrs. Pope's system. The buildings are divided into various rooms which are spanned by six steel principals 27 ft. 11 in. span, with a rise of 7 ft. 10 in., and surmounted with ventilators 6 ft. 9 in. in width.

Adjoining the goods yard are a Wagon-Repairing and a Locomotive Shed. The wagon-repairing shop lies to the south of the warehouse and on the east side of the main lines. It is divided into two spans of 31 ft. 8 in.

The engine shed also lies to the east of the main line and south of the wagon shop. It is over 300 ft. long and 97 ft. wide, and has been provided with four roads with pits. This shed will house the locomotives running between Leicester and London. The entrance openings are supported on stanchions, so made as to form jambs for the doors, which swing on the stanchions on which are cast very strong lugs, into which are fitted turned steel gudgeon pins. Over the stanchions are panelled girders to carry the gable walls. Down the centre of the shed are 19 columns 17 ft. 2 in. long spaced, 15 ft. apart. At the foot of the columns are outlet holes with planed faces and drilled and tapped holes to receive the drainage pipe connection, the rain-water passing down the inside of the column. At the top of the columns two cast-iron curved ridged brackets are attached, on which rest the wood beams forming part of the roof principals, whilst



HYDRAULIC PUMPING ENGINE, LEICESTER POWER HOUSE.



DYNAMO ROOM, LEICESTER POWER HOUSE.

on the side walls opposite the columns were fixed similarly shaped brackets with a shoe cast on for building into the wall.

The smoke funnels are supplied with steel plate hoods and cast-iron brackets. The rain-water is carried in cast-iron gutters to each column, and here a cast-iron drop is let into the column.

Adjoining the shed are an engine-room, machine shop, smith's shop, stores, mess rooms and offices.

The Power House, consisting of the hydraulic and electric machinery buildings, are situated near to the east side of the goods warehouse, and the block is in three divisions, one being the boiler-house, which is 57 ft. 7 in. long and 67 ft. 6 in. wide, and is spanned over by five steel principals which are surmounted by a large lantern light and ventilator. The principals measure 70 ft. 6 in. back to back of shoes, and the rise of the roof from shoe-plate level to ridge is 17 ft. 6 in. The ventilator is 27 ft. 4½ in. wide and 39 ft. 6 in. long, and rises 10 ft. 10 in. above the ridge of the principals. These principals are very massive, and with the lantern structure they weigh about 4 tons each. The engine-room is 39 ft. long and 35 ft. 6 in. wide, and is spanned by three steel principals, while the dynamo-room is 53 ft. 6 in. long and 26 ft. 6 in. wide and spanned by five steel principals. The engine-room is surmounted by a lantern light and swinging ventilators. The construction of the steelwork is similar to the boiler-house, excepting that it is not so massive.

The power house contains an installation of five boilers, made by Messrs. J. Adams and Sons, fitted with Meldrum's patent forced draught furnaces. They supply steam for running the dynamos and for working the double compound hydraulic pumping engine. The latter was supplied by Messrs. Tannett & Walker, and works at a pressure of from 130 to 140 lbs. The principal particulars are as follows:—

The diameters of the high and low pressure cylinders are 24 and 34 ins. respectively. The stroke is 2 ft. 6 ins. The engine stops and starts automatically. It is connected with a 22-in. ram.

The power supplied is utilised for working three 24-cwt. cage hoists in warehouse, seven 30-cwt. platform cranes in warehouse, four 8-cwt. trap hoists in warehouse, two 30-cwt. outside hoists, two 10-cwt. outside hoists, and eight capstans capable of drawing 1 ton dead weight. No water is wasted, as the exhaust is returned back. A 10-ton overhead travelling crane is also provided in engine room for assisting repairs to engine.

The Electric Power House, Leicester, contains engines of Roworth's "Universal" type, coupled direct to Royce shuntwound generators. The engines are run at a speed of 390 revolutions per minute. The current is generated at 220 volts, and is distributed on the two-wire system by underground cables to the points where it is to be utilised.

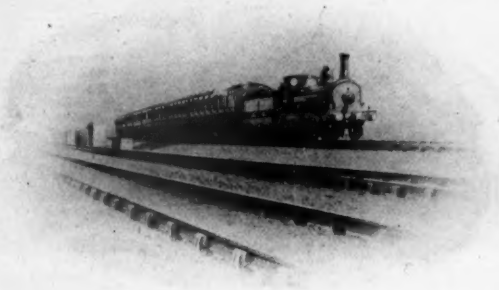
The underground cables are by Messrs. W. T. Glover and Co., lead-covered and insulated with "dentrine." They are drawn into cast-iron pipes, manholes being provided at convenient positions.

The electric installation was carried out by the Railway Lighting Company, Ltd., 78, King-street, Manchester.

In connection with the whole of the Leicester railway accommodation, thoroughness is the chief characteristic that has been displayed by the Great Central Company. Leicester wanted the new line for its extending trade and its rapidly-increasing population, and when the Great Central scheme was formulated the town welcomed it. The municipality is in possession of much landed estate, and when the new line was projected an area of land almost in the centre of the town was placed at the disposal of the Company at a nominal sum. When the Great Central responded to the wish of the municipality by designing a large and handsome station, with such ornamentation as would add to the architectural beauty of the district of the town in which it is located, the Corporation further determined that the whole scheme should be done well, and accordingly set about forming a new street, and widening others connecting with the main thoroughfares, at a cost of over £200,000. This is perhaps the best testimony as to the great value, from a commercial point of view, which is attached by the town to this great railway enterprise.

The new line will bring, among other local benefits, Manchester nearer by seventeen miles and Nottingham by several miles. It will give better facilities for the timber and fish trade from Grimsby, as well as give a new connection with coalfields in the neighbouring counties. Stone and granite quarry districts will be opened up, and the traffic since the opening of the line shows that the mineral and goods traffic will be a remunerative one for the company.

(*To be continued.*)



MACHINERY APPLIANCES AND PROCESSES.

"Every part and side of our life, from the cradle to the grave, has been touched and tended by the inventor and manufacturer. His works are as numberless as the sands of the sea, but the onward rush of Science and the Arts opens up new fields of discovery and enterprise as each day dawns. Let us choose here and there among thousands, and in choosing take the best as far as in us lies."

MELLOR'S PATENT CONTINUOUS SILK DRESSING MACHINE.

SILK has always been an article of luxury and associated with the most costly of woven fabrics. From the moment of its expulsion from the mouth of the silkworm to its appearance in choicest woven goods, the fibre has to undergo most interesting and strange processes. The thread derived direct from the cocoon by reeling is known as net or neat silk, whilst the outer covering of the cocoon, the coating of silk next to the larvæ, pieced cocoons, waste made in reeling the middle portion of good cocoons, and various other kinds of silks known as wild silks, and from which the fibre cannot be reeled for net silk purposes, are all known as waste silks, and are spun by machinery analogous to worsted and cotton machinery, into spun silk yarns, varying in value from a few pence per lb. (noil yarns) to a superior thread worth 13*s.* per lb.

It is very difficult to estimate the amount of silk waste produced in the world. One writer estimates yarn spun to be about 14

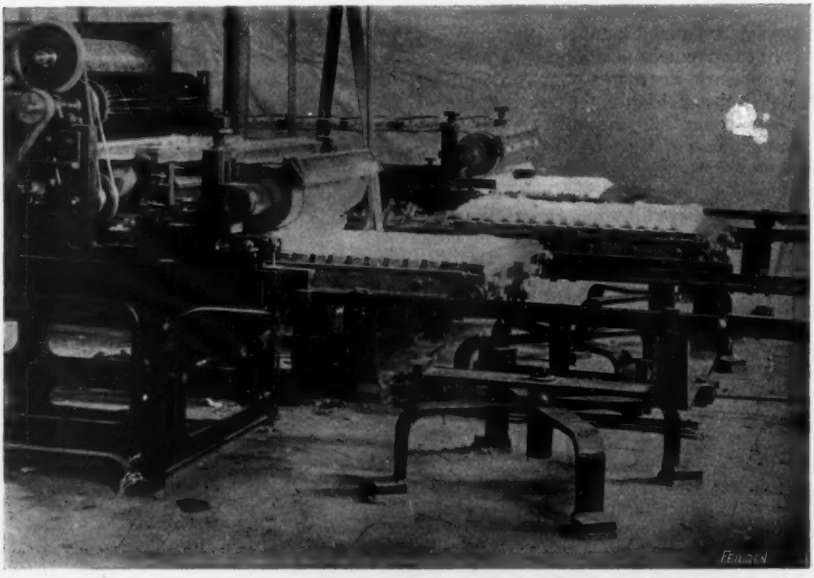


FIG. 1.—A PAIR OF MELLOR'S CONTINUOUS WASTE SILK-DRESSING MACHINES.

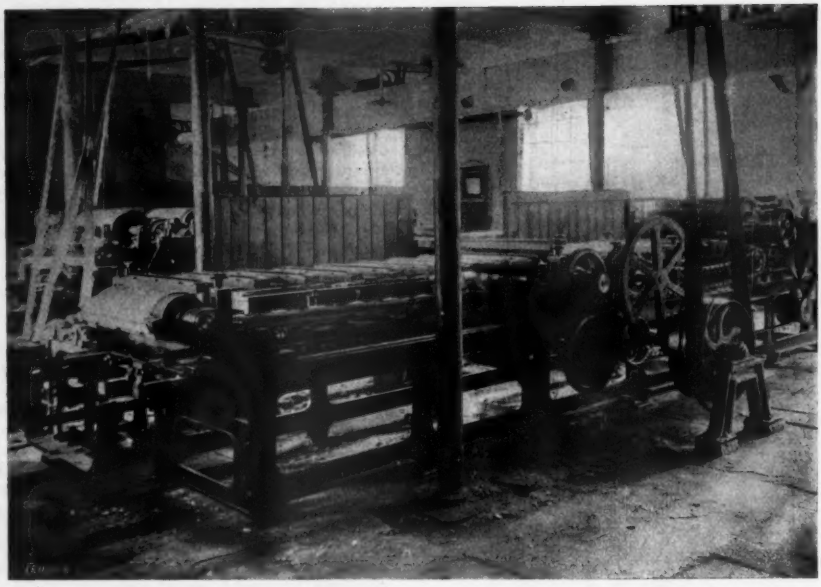


FIG. 2.—ANOTHER VIEW OF MELLOR'S CONTINUOUS WASTE SILK-DRESSING MACHINE.

million lbs. per annum, which, roughly speaking, would take up 42 million lbs. of waste, and as the process of silk-dressing is the most costly single process in a spinning mill any economy effected is of vital importance to the silk spinners of the world.

The first process to which silk is subjected is designed to dissolve the gum-deposit on the fibre, and this process is either a fermentation called schapping, or a boiling in water and soap called degumming or discharging. After degumming, the waste is in a very tangled, matted condition, needing to be straightened out and opened and made into "strips" or cut lengths of fibre on what is known as a filling engine.

These strips are placed between two hinged boards, called book-boards preparatory for the dressing frame. The dressing frame is to comb the silk waste into even lengths of fibre, so as to aid and ensure the making of a round, clean, lustrous yarn. Hitherto the dressing machines used have been known as "Circular," adopted chiefly on the Continent for schappe yarns, or "Flat," used for degummed yarns, the last named machine giving best results in quality of work and percentage of yield of dressed silk weighed in by the dresser from the weight of waste given him to dress. This "Flat" dressing frame comprises an endless sheet or belt carrying a series of combs and cards travelling horizontally around a pair of rollers: a carriage or box containing 20 or 40 bookboards of silk is brought into position under the sheet or belt of combs, and is raised vertically by the attendant dresser to a proper height in relation to the combs to ensure a graduated depth of combing. The box has to be lowered and readjusted several times to allow the fibres of silk to be gradually combed on each surface, necessitating the exercise of great care and skill on the part of the dresser, whilst limiting production —thus making the operation very costly. Numerous attempts to cheapen the cost of production have been made, but without any success, until the invention noticed here, patented by Mr. A. Mellor, manager of the extensive silk waste spinning mills of Messrs. J. & T. Brocklehurst and Sons.

The new machine is based on the same principle as the ordinary "Flat" machine, arranged to give an extended and very gradual range of dressing to the fibres at one operation, or in once passing through the machine, thus largely increasing the productive capacity of the machine, and also, by

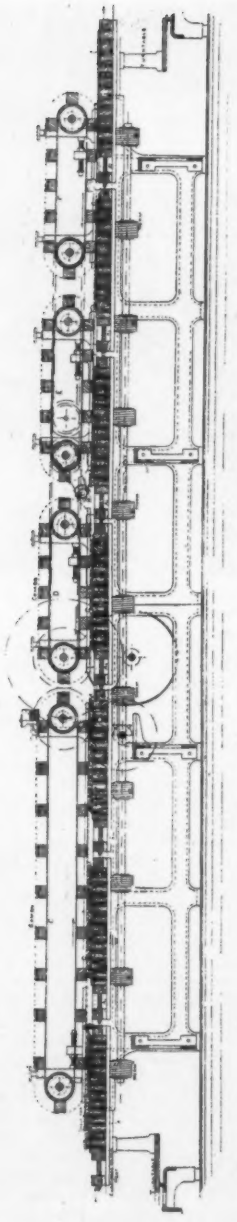


FIG. 3.—SECTIONAL VIEW OF MELLOR'S CONTINUOUS SILK-DRESSING FRAME.

reason of its automatic action, enabling cheaper and less-skilled labour to be employed, with the result of saving 50 per cent. in wages or cost of production, without in the least degree hurting the quality or yield of silk.

The action of the machine is as follows :—A carriage (A, Fig. 3) containing 10 to 20 bookboards filled with silk, the silk firmly secured by nipping tightly together the bookboards by means of screws (A1) is placed on a turntable situate at the receiving end of the first machine. Worm B on worm shaft engages with a toothed rack fitted to bottom of carriage A, and by its revolution propels the carriage forward underneath the series of travelling combs or endless sheets C, D, E, F. A series of boxes extending over the full length of the machine being operated on at the same time, and the endless sheet, C, travelling in the direction indicated by the arrow combs one surface of the fibre and endless sheet, D, the reverse side. A wiper brush, H, again reverses the tufts of silk which are operated on by cards and combs on endless sheet E on one surface, and by section F on the other surface, the sections E, F, removing the nibs off the fibres. A second machine is placed alongside the first, and the carriages being conveyed on to a turntable midway of the two machines, the bookboards are automatically unscrewed, releasing the silk, when that portion already dressed is placed in the bookboards, so that the portion previously nipped tight is then projecting ready for being dressed by the second machine in exactly similar manner as above described.

Each section C, D, E, F, together with shelf G, which shelf acts as a support to the combs and cards when they are working the silk, can be adjusted to any required angle to give any graduation of dressing, and each section can be run at different speeds, speed of carriage through the machine being regulated by means of spur change wheels. By its continuous working, a box or carriage of silk is delivered, with silk completely dressed, once every five minutes, though in its slow progress from end to end of the machines the silk has had exactly the same time—about 80 minutes—bestowed upon it as would have been given it by the attendant dresser on the old "Flat" frames, the last named turning out, say, 800 boards per week, and the new patent 6,000 boards per week.

The invention is being thoroughly tested at the mills of Messrs. Brocklehursts, and the Ford Silk Spinning Co. Ltd. The Editor of FEILDEN'S MAGAZINE will gladly supply further information.

THE JEFFERYS-APPLEBY CHAIN.

THIS chain is composed of cruciform links, the arms or flanges frictionally engaging on the inclined sides of a grooved pulley in the manner illustrated by the accompanying drawing.

A very considerable grip of the pulley is obtained by the numerous surfaces of frictional contact, in fact, by reason of the wedge-shaped form of the projecting arms of each link, the chain may be said to clutch the wheels while transmitting power.

By making the inclinations of these arms

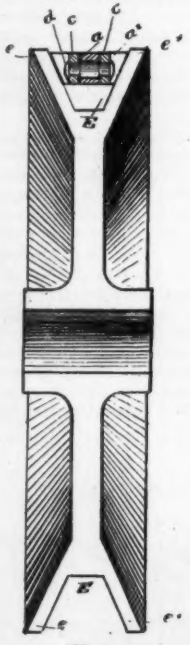


FIG. 1.

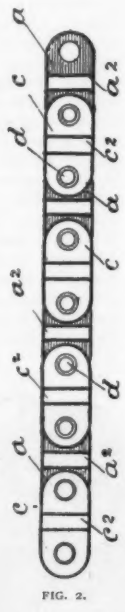


FIG. 2.

or flanges more acute, and having a pulley grooved to correspond, a much more tenacious grip can be obtained. This is a very important feature, and gives it a material advantage over the ordinary methods of transmitting power for many purposes, though if the angle of the wedges were too acute the chain would, of course, have a tendency to jam or bind in the groove.

As this chain travels over a smooth pulley, without teeth, it is not subject to the excessive wear and tear inseparable from the ordinary pitch-chain, the connecting joints of which are always in violent contact with teeth projecting from a wheel while imparting or receiving momentum. The capacity of the frictional chain under consideration is not appreciably diminished by any amount of stretching, and each link in frictional contact with the wheel bears its proportion of the strain. Another feature claimed for this chain is, that, while it grips the pulley with considerable tenacity, it is liable to slip when imparting or arresting motion or under a sudden strain, thus overcoming the inertia of parts of machinery without communicating a sudden shock, which is liable to fracture or damage them. In this respect it resembles belting, and differs from a positive drive; though far more adhesion or traction is gathered from the numerous wedge-shaped pieces, on the arc of contact, than could be developed by a far much wider leather belt, and is therefore capable of transmitting considerably more energy than a belt of the same width.

With wire cables a very considerable

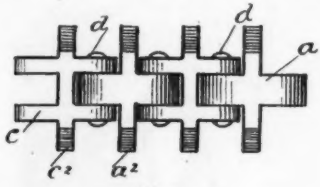


FIG. 3.

amount of energy is lost in the bending stress. Here the frictional chain claims an advantage, as it is absolutely free from bending stress.

The difficulties connected with the tendency of a wire rope to spring away from the wheel, and not to clasp it, are overcome by the employment of the frictional chain.

DESCRIPTION.

The pulley is shown in Fig. 1, having trough or coned groove *E* with inclined sides e, e^1 of greater depth than the chain, an end section of which shows how it engages the groove.

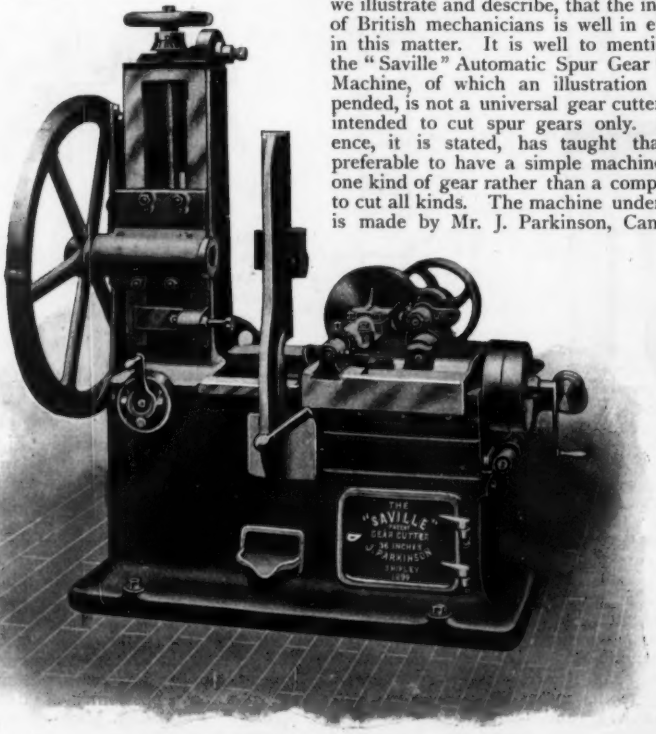
Figs. 2 and 3 show the chain in side-elevation, and under side plan a^2 and c^2 are inclined flanges or ribs projecting respectively from the inner links *a* and the outer links *c* which are coupled by cross-rivets *d*. The cutting edges of these flanges cannot touch the sides of the groove as long as the wheels are in line, but they may be rounded off to obviate any possibility of damaging the pulley. FEILDEN'S MAGAZINE will supply further particulars required.

CAST versus CUT GEARING.

THE question of cast *versus* cut gearing for machinery generally has come very much to the front during recent years. The object to be attained is, of course, smooth running, without jar or noise; and this can only be accomplished by allowing each individual tooth of the wheel to do its proper share of work. With cast gear this is not easy of accomplishment. The teeth have often to be dressed by hand, and, through the treatment of file and chisel, the proper form of the teeth is frequently destroyed, and the correct working surface lost. Thus it results that, apart from the time taken in dressing up the casting, the inequality in the thickness of the teeth, practically unavoidable from the process, injures the proper working of the wheel, since a slight variation in the teeth will tend to throw all the strain on one, or allow "backlash" between others.

Considerable ingenuity, at the same time, has been shown and great improvements made in the methods of producing cast gear wheels, and it is now possible to produce and obtain better results in this direction than was formerly the case. These improvements, however, are mainly confined to cases where repetition in large numbers is required; for small quantities, the moulder has still to make use of ordinary methods, and the machine builder has to make the best of such castings as he can get. Good cast gear wheels undoubtedly possess one advantage over cut gears, inasmuch as the skin on the teeth left by casting is somewhat harder than the skin left by cutting. Where accuracy, high-speed, smooth and quiet running are not required, good cast gears may be adopted; but where these conditions are essential, cut gears have indisputably the superiority.

The machinery for producing cut gears has reached a high state of development, and it is gratifying to see, by the machine we illustrate and describe, that the ingenuity of British mechanicians is well in evidence in this matter. It is well to mention that the "Saville" Automatic Spur Gear Cutting Machine, of which an illustration is appended, is not a universal gear cutter, but is intended to cut spur gears only. Experience, it is stated, has taught that it is preferable to have a simple machine to cut one kind of gear rather than a complex one to cut all kinds. The machine under notice is made by Mr. J. Parkinson, Canal Iron



THE "SAVILLE" AUTOMATIC SPUR GEAR CUTTING MACHINE.

Works, Shipley, Yorkshire, who has already achieved a considerable reputation in connection with his Anglo-American Lathes and other modern machine tools, and whose name affords a guarantee of the highest type of material and workmanship. It may be noted that Mr. Parkinson has put his machine to a very practical test, having had gear wheels cut on the most advanced type of American machinery, and compared the results with wheels cut on the "Saville," which have been proved equal in every respect to the best practice outside this country.

As will be observed, the "Saville" machine is simple in both design and operation. The gear blanks to be cut are mounted on a mandrel fitted on a horizontal spindle, on which is fixed a large accurately cut division wheel. The divisional wheel is operated intermittently by a train of gearing controlled by the movements of the slide carrying the cutter. The amount of intermittent movement of the division wheel determines the number of teeth to be cut on the blanks, and this can be varied by a combination of change wheels provided for the purpose. Pitches up to 100 to 400, prime numbers excepted, can be cut with the change wheels supplied. When the adjustments have been made, the machine may be started, and requires no further attention until the cutting of the wheel is completed. Wheels can be cut up to 36 ins. diameter by 9 ins. on the face, the machine weighing approximately 16 cwts. 2 qrs.

ANTI-FRICTION ALLOYS.

THOUGH the employment of a metallic alloy for the purpose of reducing friction on bearing surfaces dates back from a comparatively distant period, it is only during recent years that the use of anti-friction metals has increased so rapidly as now to constitute the manufacture of such alloys an industry in itself of appreciable importance. The idea of alleviating friction on bearings by the employment of a ductile metal was in the first instance of American origin; and for many years, what is still known as Babbit's metal enjoyed a vogue which in some degree it still retains, though it has become supplanted to a large extent by improvements.

When any bearing surface—even the most highly finished journal—is examined under a strong magnifier, it will be found that, however perfectly it may have been finished, its surface is still covered by minute serrated edges and roughnesses. A good anti-friction metal, essentially soft and ductile in its nature, is picked up by these edges, and the anti-friction metal forms a kind of skin on the harder surface, by which a great portion of the friction is done away with. From a

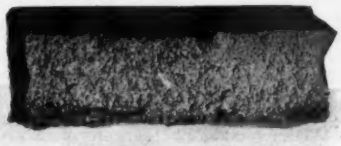


FIG. 1.—FRACTURE OF ORDINARY ANTI-FRICTION METAL.

consideration, therefore, of the essentials necessary to the fulfilment of the function described, it will be seen that a good anti-friction alloy should (1) be able to withstand high pressures without crushing; (2) high speeds without melting, or *seizing*, as it is technically described; and (3) that it should possess the least possible frictional co-efficient. For the attainment of these desiderata, it is incumbent that the alloy of the highest type should (1) be composed only of the best and purest materials; (2) that the proportions should be correctly ascertained and carried out in mixing; and (3) that the manufacture, by which is intended the temperatures and periods at which the ingredients are added during their melting and incorporation into the finished product, should be carefully carried out.

It is incumbent that the best anti-friction metal should be alloyed, with special regard

FIG. 2.—FRACTURE OF "ATLAS" ANTI-FRICTION METAL.

to the temperatures and periods at which the various ingredients are put together.

Superficially, it would at first appear that the manufacture of anti-friction alloy—the ingredients of which are pretty well known—was a matter of the utmost simplicity. Experience, however, has shown that many technical points, an acquaintance with which can be attained only by extended experience,

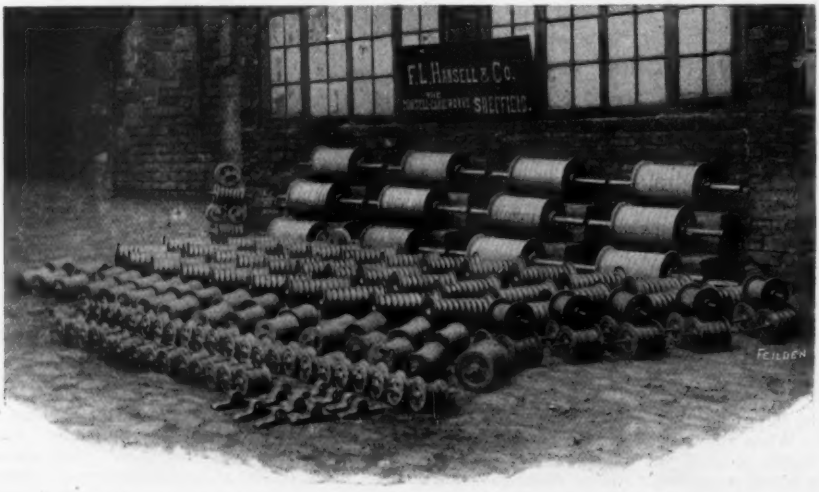
practical knowledge and manipulative skill, are required in the preparation of an alloy that shall give the highest results under proper tests. To illustrate the statements just made, it is only necessary to point to the following fact. It is quite possible to take the same proportions, and identically the same ingredients, and by a slight variation in the procedure of casting to obtain two entirely different fractures, and therefore two different results, in the finished cast metal. The form of "fracture," we may mention, is a rough and not altogether reliable indication of quality.

We have taken photographs of two of the chief metals on the market, and though the results are not so clearly expressed as they should be, it will be observed that one of the examples (No. 2) has a much finer texture in its fracture than the other. The latter is the British metal to which we refer later.

Inasmuch as two of the anti-friction metals now being most actively pushed on the British markets are respectively of American and German manufacture, it affords us much pleasure to refer to a purely British anti-friction metal which is now enjoying a large sale, under the auspices of Anti-Friction Alloys, Limited, to which company we are indebted for a part of the information detailed in this article. Anti-Friction Alloys, Ltd., lay stress on the fact that both of their anti-friction metals, "Atlas" Metal and "Alba" Metal, are produced by British workmen from British materials only, in their own well-equipped works, which have been inspected by and received the certificate of H. M. India Office, to which the Company are contractors. The "Anti-Friction Alloys" Company's metals are produced under a secret process, but the Company guarantee that only ingredients of the highest quality and of absolute purity are used in their manufacture. It is possible, the Company point out, to produce so-called anti-friction metals by melting down "scrap" of different descriptions at a cheaper rate, but, as they legitimately state, purity is an absolute *sine quâ non* to high quality, a postulate which has also been proved in a practical way by "Atlas" Anti-Friction Metal having, as stated, replaced a considerable body of foreign manufactured products of the same class.

THE "CORRU" HAULAGE ROLLERS.

A PATENTED form of haulage rollers has been introduced with a view to improving the running, and reducing the wear and tear upon the wire rope used in connection with mining and other descriptions of industrial haulage. In mines, collieries, brick-fields, and the like, the cost of maintaining the wire haulage ropes in efficient condition constitutes no inconsiderable item in the working expenses, and while the quality of the ropes has frequently much to



A GROUP OF "CORRU" HAULAGE ROLLERS.

do with the amount of this expenditure, a large proportion of it may more often than not be attributed to the unnecessary and excessive friction caused by the guide rollers and haulage pulleys exerting a sawing and tearing influence upon the wire ropes as they pass over them. Sometimes these rollers are turned out in the most perfunctory fashion, being so lop-sided that when the rope bears upon them they fail to respond promptly and smoothly to the travel of the rope, and not infrequently become fixed and jammed. The result is that the strands of the rope suffer undue wear and strain, and its outer surface becomes rapidly deteriorated.

To remedy these evils the patent "Corru" haulage rollers, which we illustrate, were introduced, and we understand that they have been found to answer their purpose efficiently. The corrugations or channels along the barrels of the rollers afford a greater amount of binding or gripping surface to the rope than do flat rollers, and the circular form is so true that the slightest contact with a travelling rope serves to cause them to revolve. Those practically acquainted with haulage know that the ropes seem to have a preference for roller "ends" or "corners" where the barrel and flange meet, and when a groove gets worn in the barrel the rope is pretty certain to find its way there and elect to run therein.

The "Corru" rollers, as their name suggests, are corrugated or grooved along their entire lengths, and these grooves seem to get in practice a fairly equal amount of usage, according to the limit of curvature of the wagon way. These rollers are made of tough iron or steel, are well balanced and true, of equal thickness, and of diversified shapes and sizes, to suit specific requirements. A group of "Corru" haulage rollers is illustrated on page 486.

PRELIMINARY NOTICE.

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AUTOMATIC RAIL-JOINT SPRING.

THE appliance designated under this heading relates to an improvement, as claimed, upon the existing method of jointing rail sections. Instead of the rigid fastening at present commonly in use, the system under notice consists of a heavy curved strap string, with the concave side of the curve to the fish-plate or frog, and with a threaded nut through it, as a part of this spring, at about one-third the distance from one end, leaving the extending spring longer on one side of the nut than on the other.

The concave side of the spring sets against the fish-plate or frog, and is drawn down

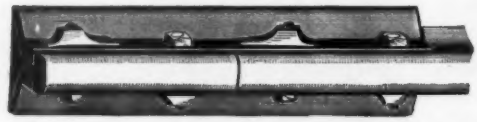

FIG. 1.

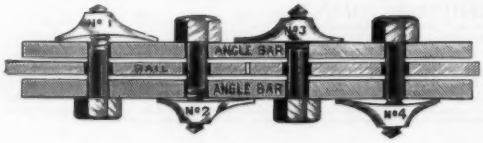

FIG. 2.

FIG. 3.

against it by a square headed bolt from the opposite side of the rail, and through the nut, until the spring lies practically flat against the fish-plate or frog. Two of these springs are to be placed on each side of the joint laterally, and they can be put all on one side of the rail, or two on one side and two on the other, as preferred. The four track springs exert, as stated, a combined squeezing pressure on the joint of at least 12,000 lbs., and thus ensure no relative movement of the parts while the load is passing over it. The frog and crossing bolts are claimed to exert a pressure of over three tons each. A great saving of bolts is stated to be thus effected, as they are never damaged from being over-strained, the spring never being drawn quite flush with the fish-plate. It is obvious that a considerable economy of labour is another result of the contrivance.

We illustrate in Figs. 1, 2 and 3 details of the adjustment, which has been practically tested in a trial made on the Great Northern Railway in April of this year, with, as we are informed, very satisfactory results. Six important railway lines in the United States have adopted the system, and, although the permanent ways in that country are much inferior to those of our own, there can be little doubt that the invention under notice is entitled in a material degree to the attention of British railway engineers. As a matter of fact, on the Great Northern Railway the bolt and spring have required no attention since the day they were put on—eight months since; and on the United States railways much longer trials have taken place, with a similar result. It may be assumed, therefore, that although these appliances cost slightly more in the first instance, the saving in labour will repay the outlay in a very short time. Trial orders, as we have been informed, have been given by English railways—amongst others, the Great Western, Midland, London and North-Western, Lancashire and Yorkshire.

A HINT to BRITISH MANUFACTURERS!

Her Britannic Majesty's Consul at Lisbon, in an interesting letter to the Editor of FEILDEN'S MAGAZINE, says: "I consider it (the Magazine) in form, style, and general information a most valuable addition to the industrial literature of the United Kingdom, and well calculated to advance the interests of our manufacturers."

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are invited to forward advance particulars of any new machinery appliances or inventions they are interested in or putting on the market, when the Editor will be pleased to introduce same to his readers through the literary columns, free of cost.

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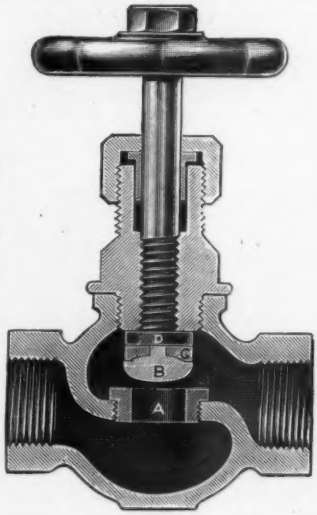
THE "SHAW" IMPROVED VALVE.

THERE are so many varieties of valves for steam, water, air, gas, and other effective agencies that it almost seems as if the market must be more than supplied, at all events, in the matter of variety. Still, a valve, while, after all, a rudimentary kind of mechanical contrivance, is, like many another simple device, a difficult thing to obtain in a really dependable and efficient condition. Some descriptions having a paper reputation prove very questionably efficient in actual practice, and others, again, which are constructed on the most scientific principles, do



SECTION OF THE "SHAW" VALVE.

not pan out satisfactorily when they come to the crucial test of daily work. It behoves machinery users, therefore, to give a fair amount of consideration to the productions of every maker who can place a valve on the market with any rational claim to improved construction or superior workmanship.

In the case of the "Shaw" improved valve, there are various points which will commend themselves to the practical man. The valve is illustrated in the accompanying sectional view, in which A is the valve seat, B the valve itself, and D the special packing ring, which is an important feature of the invention. Commencing with the valve seat, it may be mentioned that it is made of a metal which is stated to be specially prepared with a view to effectually resisting the action of steam, and is considerably harder than that of which the valve is made, being consequently less liable than would otherwise be the case to injury from the incursion of grit or other material between the seat and the valve. There is another point in favour of this construction which should not be lost sight of, and that is, that if from any cause the valve seat should become damaged, it can be replaced with a new one at a small cost without removing the body from its permanent position—a circumstance which will immediately commend itself to the practical engineering mind.

Then, as to the valve itself, more particularly, we may say that it is structurally distinct from the spindle, and is made in a concentric form, producing a metal-to-metal joint with the seat A, which will resist any pressure likely to be brought upon it under normal conditions. There is certainly no complexity about the construction of the valve, and there is no reason to dispute its strength. It finds its true centre on the valve seat naturally, and its working conditions are such as will accommodate themselves to the variations liable to be caused by wear and tear of a strain upon the spindle. There are differences of opinion amongst engineers as to whether metal-to-metal joints, for steam purposes at all events, are always the best, and good arguments can be offered on both sides, but probably the balance of the reasoning is in favour of a metal-to-metal joint, such as is provided in the case of the valve under notice. When it becomes worn or injured in ordinary course it may, at all events, be rendered almost as efficient as when new by the simple expedient of re-grinding; but the makers of the valve are willing to meet differences of opinion on the subject very fairly, and undertake to supply composition discs or valves, made from a special material, which they guarantee shall wear well under the action of steam. The special packing ring, shown at D, provides for the repacking of the stuffing-box at any time without the shutting off of steam. Its special function on the spindle is, of course, to prevent, when the valve is open, any escape of steam, even if there were no packing in the stuffing-box; in other words, the spindle is double packed.

Its structural advantages include a special renewable metal seat, A; the interchangeable valve made of special metal or fibrous composition, B; and the special packing-ring on the valve-spindle, D. The production of a well-known maker, Mr. Joseph Shaw, Albert Works, Huddersfield.

Recent American Inventions Introduced into Great Britain.

THE WESTINGHOUSE GAS ENGINE.

IT is generally known that a gas engine is now being built to develop no less than 1,500 indicated horse-power. This is so utterly beyond all previous conceptions of gas motors that the interest with which the experiment is being regarded, both in the United States and this country, is sufficiently warranted. The largest engine ever erected on the Otto principle was, we think, installed in France, at Partin, four or five years ago. It was rated at 625 brake horse-power, but in reality this engine was composed of two engines coupled together, though the foundation plates were in one piece.

The Westinghouse gas engine, of which so much has been heard, appears likely to inaugurate a new era in this class of motive power. It has taken, as we are told by the inventor, "more than ten years of patient investigation and experiment" to develop the engine to its present state. To illustrate the advance which this remarkable example of mechanism constitutes on heretofore existing practice, it will be sufficient to quote some figures whose authenticity can be vouched.

The Westinghouse gas engine has shown an efficiency at the shaft of no less than 28·2 per cent., taking nine cubic feet of gas calculated at 1,000 British thermal units per foot of gas. This performance may justly be described as phenomenal. Taking a few instances of old-time practice, the comparison is striking. The Lenoir engine, for example, of 1861 took practically 90 cubic feet of about 700 heat unit gas per brake horse-power per hour. The Otto-Langen engine, brought out in or about 1867, took, according to Tresca, 44 cubic feet per hour. The "Otto cycle," introduced in 1876, constituted a revolution in gas engines, yet the consumption at that time was not less than 30 cubic feet per brake horse-power hour. Yet the remarkable efficiency we have referred to—28·2 per cent.—unprecedented in the history of gas engines, is not deemed by the makers to be the limit of the attainable. The makers express the firm belief that the everyday performance of the Westinghouse gas engine will, within a short time, reach 33⅓ per cent. From what we have seen of the engine, we venture to express the opinion that the faith in the engine is well warranted. We give here (Fig. 1) an indicator card showing what is represented to be the everyday performance of the engine under overload, rated load, half load, and no load. But, as before stated, Westinghouse engines are now running, giving even better results than those represented in the diagram.

In external appearance, the Westinghouse gas engine shows a radical departure from the type of gas engine to which we have been accustomed. It is compact and substantial, having a marked resemblance in appearance to the Willans' Central Valve steam engine. Its governing principle, and that which sets it apart from all other types

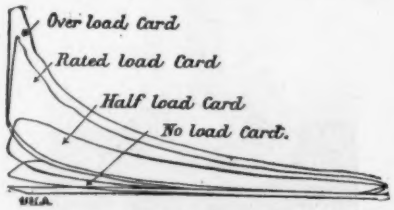


FIG. 1.—INDICATOR CARD, WESTINGHOUSE GAS ENGINE.

of gas engines, rests in the gas-cylinder and the mechanism controlling the admission of gas and air. In the ordinary Otto cycle engine the governing is controlled by what has been aptly described as the "hit-or-miss" contrivance, seeing that although by it one or more charges can be cut out, yet the engine must either take a full charge or none at all. This defect is most evident where steady running, such as that for incandescent electric lighting, is required. It is stated that with all the devices employed to produce steady running in the Otto engine, such as heavy fly wheels, balance wheels, and jack shafts, the variation in the voltage on a 100-volt circuit is usually 3½ to 4 volts during the cycle. The Westinghouse, on the other hand, has a mixing valve which proportions the charge in accordance with the load. This is shown in the annexed illustration (Fig. 2). It will be seen that the

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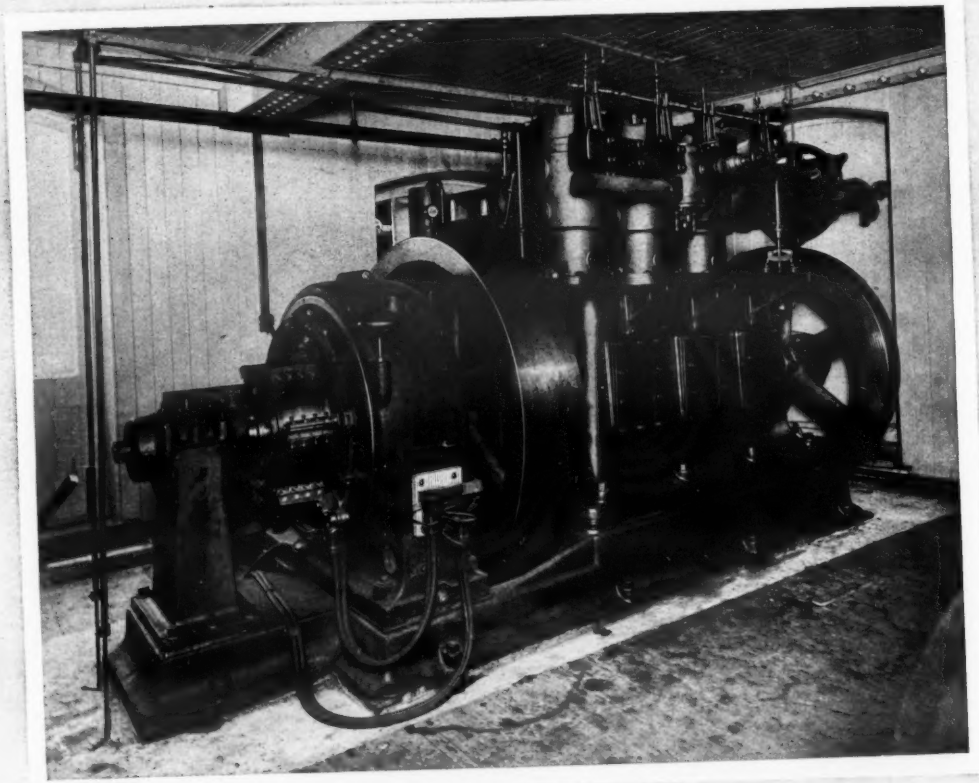


Photo by the Feilden Press.

125 H.P. COMBINED WESTINGHOUSE GAS ENGINE AND GENERATOR.

device is in reality a proportional meter, and preserves the proportions between the gas and air whether the engine runs at no load or at full load. The gas and air are mixed in the cylindrical mixing valve *A* in the proportions at which the valve is set. The governor *B* in connection with this valve has absolute control over the amount of explosive mixture to be taken into the cylinder through the channel *C* and the inlet valve *D*. The charges are ignited by an electric igniter, shown by *F*. The igniter is duplex, and composed of two separate mechanisms. This construction renders it possible to change the connections of the wire from the

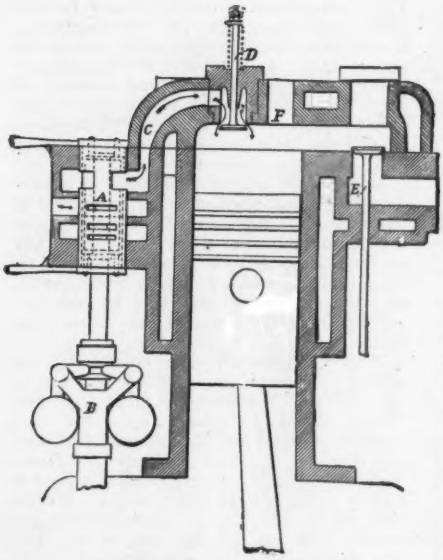


FIG. 2.—MIXING VALVE, WESTINGHOUSE GAS ENGINE.

battery to either set of terminals while the machine is running. The mode of governing is similar to that of the steam engine, and it is claimed that for picking up a heavy load it is even superior. All the charges, as explained, are proportioned to the load, and if the load is suddenly thrown off, there is one heavy charge already locked in which cannot be removed, although the governor acts instantly. In effect, the Westinghouse Company claim that they secure as good regulation either under rapid fluctuations from no load to full load, or with gradual variation of load, as that shown by the usual type of first-class steam engines used for electric lighting in this country.

The Westinghouse Company are now, as we have already indicated, building a gas engine to give 1,500 brake horse-power. This is of the three-cylinder type, and is designed to run at 100 revolutions per minute. Remarkable economy is expected from this engine, it being confidently anticipated that one brake horse-power will be developed for every $8\frac{1}{2}$ cubic feet of natural gas consumed per hour; that is to say, 8,500 British thermal units per brake horse-power-hour. This would give a heat efficiency of $\frac{2545}{8500}$ = about 30 per cent. at the shaft. If we accept this estimate as warranted, it will be at once seen that the gas engine is entitled to take its place with steam as a prime motive power. It is stated, and there appears no reason to doubt it, that a gas engine of such size and efficiency will run constantly on less than one pound of coal burned in a good producer gas plant per brake horse-power. At least twice the amount of fuel would be required by the highest grade steam engine.

If we accept the position of this gas engine to be as stated, it will be interesting to indulge in a few speculations as to the future that may be presumed to lie before this new prime mover. In an ably-written and interesting pamphlet recently issued by Mr. George Westinghouse, we are afforded some information on this point. Bearing in mind the fact that the Westinghouse gas engine runs direct coupled with a dynamo, we have before us the prospect, lucidly indicated by Mr. Westinghouse himself, involving a theory of a daring though obvious character that has already excited no little attention. As a matter of fact, Mr. Westinghouse suggests that gas companies should supply electric current. The author says:—"Gas companies are naturally anxious to find some way to meet the public demand for electric light by the utilisation of their present systems of distribution, rather than by the establishment of electric light and power stations of the character heretofore erected. * * * They know that they have their systems of distribution now laid within reach of a greater business than the electric companies can provide for during the next quarter of a century, and that to give their property a proper value there is required only some reliable and economical way of converting their gas into electricity. * * * With the Westinghouse engine and electric generator operating at full load, 1,000 cubic feet of illuminating gas will produce about 40 kilowatt-hours, which, at the retail London rate of 2*s.* 6*d.* per 1,000 cubic feet, amounts to $\frac{3}{4}$*d.* per kilowatt-hour, making, with an

equal amount for attendance, maintenance, and depreciation, 1½*d.* per kilowatt-hour. The prevailing selling price for electric current is from 4*d.* to 6*d.* per kilowatt-hour. * * * A Westinghouse engine and electric generator, even of the moderate size, can be installed ready for operation at a cost per 16 candle-power light capacity of less than half the capital required for a steam engine central station plant, and its system of distribution. A careful inspection of the very latest electric plans," pursues the author, referring in this case to electric traction, "would disclose the following general outline: A large central steam power and electric generating plant, the electric generators being of the multi-phase type for the generation of currents at very high voltages; a high-tension system of distribution to take these currents to local stations where there are step-down transformers, which supply alternating currents to rotary transformers, which in turn feed direct currents to third rail or other circuits for the operation of motors on the railways.

"There seems no reason to doubt that coal can be made into gas of a satisfactory quality at gas works suitably located, and can be taken by pipes to gas engines placed in the positions corresponding to the sites of the rotary transformers of the foregoing plan, for a capital expenditure greatly below that required for an equivalent steam boiler and engine plant. The cost of fuel per electrical horse-power so delivered should not exceed 50 per cent. of the cost of the fuel for generating electricity by steam for similar service.

"At the present time projects for the electric equipment of London underground and tram railways are under discussion. The use of gas engines for developing the electrical energy, with suitable pipes laid for conducting the gas, would make the cheapest system to construct and operate. It should be quite within the scope of the operations of existing gas companies to erect special gas works, put down special pipes, and supply gas for the operation of large unit gas engines in connection with such lines, as well as for those now being built in London, and for those in contemplation. The gas companies could avail themselves of the most recent processes for the generation of gas, such as Dr. Mond's system, the Otto-Hoffmann system of Germany, or the Dowson system, all well developed and understood.

"A further plan would be to place the gas-engines and electric generators in a station corresponding to that now selected for steam-engines, and operating the gas engines by means of what is known as producer gas, requiring less than one pound of coal per horse-power developed. But for simplicity and certainty of operation, the central station generating gas plant, with mains for carrying the gas to the engines, becomes the most reliable and attractive plan, after a long consideration of the subject, and especially in view of the value of the by-products recovered in large gas plants."

If Mr. Westinghouse's propositions are tenable—there is no doubt they open a wide field of discussion—a very important field lies open to gas works, whether municipal or privately owned. The larger proportion of the latter, being limited companies, would probably be debarred by their articles of association from the production of electricity. This, however, is of course a mere technicality, easily overcome. Mr. Westinghouse, it may be mentioned, states that if any given gas company were to supplant its present gas illumination by an equal amount of electric light obtained from gas engines and dynamos driven by its gas, it would have left for sale for other purposes over 60 per cent. of its present gas output.

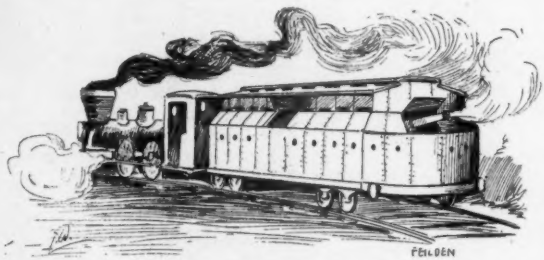
A statement like this, made on the authority of a distinguished engineer, is entitled to the attention it will doubtless receive. There can be no doubt that the Westinghouse gas engine is as great an advance on the Otto as the Otto in its time was on its predecessors, and that its advent will lead to very important industrial developments in the near future.

It only remains for us in concluding this article to express our acknowledgments to the British Westinghouse Electric and Manufacturing Company, Ltd.—the corporation formed for the manufacture and exploitation of these engines in Great Britain—for their courtesy in affording every facility to our photographers at their laboratory, where a number of Westinghouse gas engines are in regular operation. The one depicted in the supplementary plate contained in this issue was specially photographed by us with flash light, and portrays a 125 h.-p. engine. The height of this engine is 9 ft. and the fly-wheel 6 ft. 3 in.

SUBSCRIBERS to "FEILDEN'S MAGAZINE" are reminded that the Editor will be pleased to hear from them with advance particulars of any new machinery or specialities they may be bringing out or interested in. Nothing mediocre, stale, or commonplace will, however, find room in these columns.

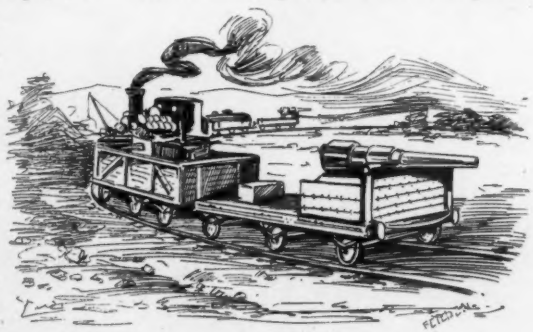
. . . ARMOURED TRAINS. . . .

IT seems probable that in the future armoured steam-propelled carriages, or "batties," may play a more important part in warfare than they have hitherto done. The services they can render under certain circumstances is undeniable, and it seems astonishing to us that British military engineers have not given greater attention to their construction and equipment. Of course, as with a great many other utilitarian devices, the Americans were the first to construct an actual armour-plated train. During the civil war in the States a mob destroyed the bridges on the Philadelphia, Wilmington and Baltimore Railway, and in order to prevent a recurrence of the disorders, and to protect the line generally, the Government hit upon the expedient of converting a long, flat, baggage car into a small movable battery. The car was built up and covered in with thick sheet iron, in which were pierced a number of loopholes for musketry. Port-holes were arranged in the centre and at each end, and a cannon on a traversing turntable was mounted for duty at each or either of the portholes. The projectiles used were of a somewhat extraordinary character, being nothing more nor less than the discs cut from the boiler plates. It was some time before this, however, viz., in 1849, that an Edinburgh man approached the late Duke of Wellington, during troublous times, with a scheme for a moving series of batteries for coast protection, but the same kind of objections were rampant at that period as Stevenson encountered some years before. It is not surprising to learn, therefore, that the novel suggestion fell on stony ground and bore no fruit, the pretext being, we believe, that of the costliness of the project.



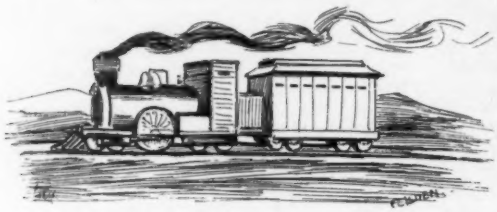
ARMOURED TRAIN USED IN THE AMERICAN CIVIL WAR, 1861.

Perhaps the most effective use of armoured trains, up to recent years, was made by the French during the siege of Paris. In these trains both engines and carriages were bullet proof, and contained a number of loopholes. Each train, carrying four small cannon which could be readily and expeditiously manœuvred from the train, was capable of holding 500 men. Considerable use was made of these trains in bringing in provisions to the beleaguered Frenchmen, and they were turned to account by the Communists afterwards against the Government troops, until their position was outflanked by heavy naval guns. Coming down to the year 1882, Great Britain found an armoured train one of the most effective and formidable contrivances in our operations against the Egyptian rebels under Arabi Pasha. It might be mentioned, however, that this train was not "built up" or armoured in the same style as the examples previously mentioned. It was really only partially protected by boiler plates and sandbags. A number of the latter were arranged round the locomotive to protect the more vulnerable parts, and the boiler plates



ARMOURED TRAIN USED IN EGYPT, 1882.

were roughly attached to the sides of the following trucks, the foremost of which carried a 40-pounder Armstrong gun, another a couple of 9-pounders on field carriages, whilst

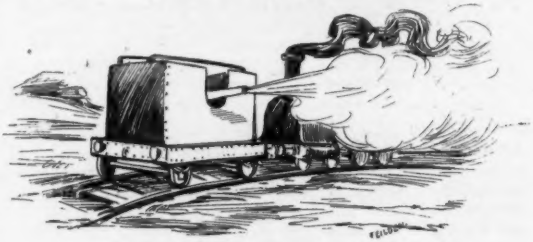


ARMOURED TRAIN USED IN CUBA, 1897.

interspersed between were a number of Nordenfelts. By a series of clever military manœuvres, this train was of the greatest possible value in the campaign, as was also a similar contrivance used at Kassassin, previous to the British advance on the lines of Tel-el-Kebir. This, however, merely carried a 40-pounder Armstrong in advance and a Gatling at either side. With regard to further examples of the use of armoured trains it is recorded that one was operated in Chili during the civil war, and a sand-bag protected or "armed" train equipped with a field gun was utilized with advantage in the Soudan quite recently. In Cuba a locomotive and truck, protected with ¾ in. boiler plates was sent in advance to pilot and protect from the rebels the trains running between Colon and Santa Clara.

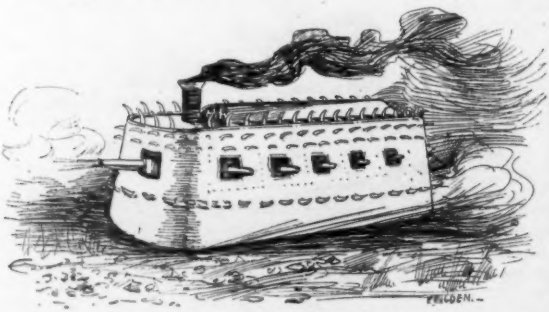
The armoured train has already attained some degree of prominence in the Transvaal War. It scarcely needed, however, the effective pounding recently meted out to the British train on its way to Mafeking by Boer artillery to demonstrate that these vehicles are not constructed to resist anything beyond rifle bullets. The South African armoured trains now being employed by the authorities consist of nothing more nor less than ordinary cars covered over with from half to three-quarters of an inch of common steel, the locomotive being similarly protected, and a car placed in front with a gun in advance. These trains are, of course, of little or no use if the line falls into the hands of the enemy, a few dynamite cartridges, or the removal of a rail or two (as was painfully demonstrated in the recent disaster to the Mafeking train), would render them a source more of danger than service.

It may not be generally known that we have in our own country at the present time an armoured gun truck, constructed for



ARMOURED TRAIN BELONGING TO THE 1ST SUSSEX ARTILLERY VOLUNTEERS.

experimental purposes for use in shore defence. The vehicle is manned and controlled by the 1st Sussex Volunteer Artillery, and the trials made have been fairly satisfactory. It is scarcely necessary to say that it needs an expert marksman to manipulate effectively a gun from a quickly moving train. The gun used in the above-mentioned train is a 40-pounder Armstrong, mounted on a turntable placed on a flat truck. The gunners are protected by a shield 6 ft. high, forming three sides of a square and revolving with the gun. The locomotive is steel-protected and draws two steel-plated carriages. The French have also constructed a number of protected trucks, placed on lines



THE GERMAN EMPEROR'S PROJECTED "WAR-CAR."

just behind parapets, with guns mounted in such positions that they can be fired over the heights immediately in front of them.

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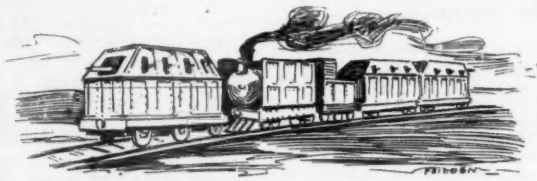

LATEST TYPE OF ARMOURED TRAIN; IN USE IN SOUTH AFRICA.

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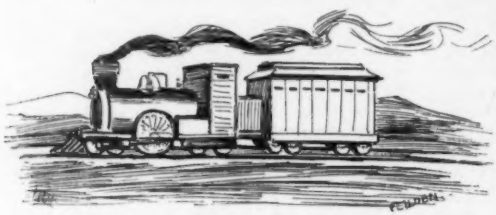
were roughly attached to the sides of the following trucks, the foremost of which carried a 40-pounder Armstrong gun, another a couple of 9-pounders on field carriages, whilst

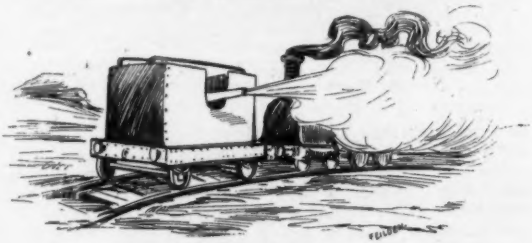


ARMOURED TRAIN USED IN CUBA, 1897.

interspersed between were a number of Nordenfelts. By a series of clever military manœuvres, this train was of the greatest possible value in the campaign, as was also a similar contrivance used at Kassassin, previous to the British advance on the lines of Tel-el-Kebir. This, however, merely carried a 40-pounder Armstrong in advance and a Gatling at either side. With regard to further examples of the use of armoured trains it is recorded that one was operated in Chili during the civil war, and a sand-bag protected or "armed" train equipped with a field gun was utilized with advantage in the Soudan quite recently. In Cuba a locomotive and truck, protected with $\frac{3}{8}$ in. boiler plates was sent in advance to pilot and protect from the rebels the trains running between Colon and Santa Clara.

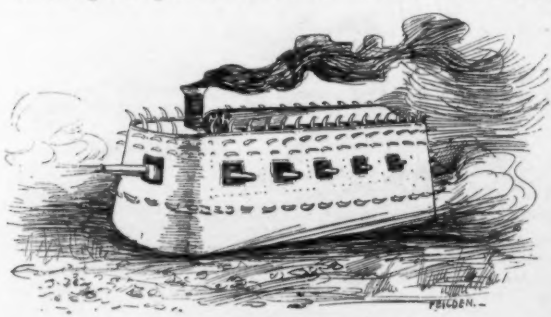
The armoured train has already attained some degree of prominence in the Transvaal War. It scarcely needed, however, the effective pounding recently meted out to the British train on its way to Mafeking by Boer artillery to demonstrate that these vehicles are not constructed to resist anything beyond rifle bullets. The South African armoured trains now being employed by the authorities consist of nothing more nor less than ordinary cars covered over with from half to three-quarters of an inch of common steel, the locomotive being similarly protected, and a car placed in front with a gun in advance. These trains are, of course, of little or no use if the line falls into the hands of the enemy, a few dynamite cartridges, or the removal of a rail or two (as was painfully demonstrated in the recent disaster to the Mafeking train), would render them a source more of danger than service.

It may not be generally known that we have in our own country at the present time an armoured gun truck, constructed for



ARMOURED TRAIN BELONGING TO THE 1ST SUSSEX ARTILLERY VOLUNTEERS.

experimental purposes for use in shore defence. The vehicle is manned and controlled by the 1st Sussex Volunteer Artillery, and the trials made have been fairly satisfactory. It is scarcely necessary to say that it needs an expert marksman to manipulate effectively a gun from a quickly moving train. The gun used in the above-mentioned train is a 40-pounder Armstrong, mounted on a turntable placed on a flat truck. The gunners are protected by a shield 6 ft. high, forming three sides of a square and revolving with the gun. The locomotive is steel-protected and draws two steel-plated carriages. The French have also constructed a number of protected trucks, placed on lines



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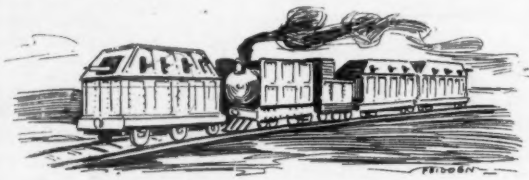

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INDUSTRIAL PROGRESS

ENGINEERING NOTES AND COMMERCIAL INFORMATION

FROM ALL SOURCES.

CIVIL AND MECHANICAL ENGINEERING.

Steel as a Material for Locomotive Boiler Tubes.—The high prices of copper and brass have caused some experts in India to advise the use of steel tubes for locomotive boilers in place of those of copper and brass. On the Madras railway nearly all descriptions of tubes have been tried, viz., ordinary brass and steel, Howell's homogeneous steel copper-coated tubes, Howell's homogeneous steel copper-sleeved tubes, Allen Everett's red metal tubes and copper tubes. The results have not been very satisfactory owing, it is said, to the water used. The South Indian Railway also condemns steel tubes and prefers brass ones. Burmah railways use steel tubes. They say with the worst water steel tubes last only some three years, while brass will last ten to twelve years. The G. I. P., Bhavanagar G. J. P., and Barsi Light Railways are averse to using steel tubes by reason of the bad quality of water on their lines; but the B. B. and C. I. and R. M. Railways state that, for some years past, steel tubes, both solid-drawn and cap-welded, have been used with great success on their lines; and that for the last ten years at least no brass tubes have been indented for. It has been found from experience that cap-welded steel tubes, which cost much less than solid-drawn steel tubes, are good enough if obtained from reliable makers on Indian State railways.

Heating Furnaces with Oxygen Gas.—It has long been known that by passing a current of oxygen over a bed of carbon very high temperatures can be obtained; but the expense of the oxygen has hitherto rendered this manner of its employment prohibitive. According to the estimates, however, of Professor Linde, oxygen may now be produced at a cost of a little under a fifth of a penny per cubic metre; and it is now possible, owing to this low price, to employ air enriched with oxygen in both chemical and metallurgical furnaces. Some important results are also expected from the employment of oxygen in connection with water gas. It is well known that the production of water gas is an intermittent one, consequent on the alternate passage of air and steam through incandescent coke. The coke, however, rapidly yields up its heat to the steam and cools, growing black, and the supply of steam has to be stopped so that the coke may be re-heated to its previous temperature. Professor Hempel, however, has demonstrated theoretically that in using air enriched with oxygen the temperature of the coke can be maintained to an effective point during the passage of the steam, and that consequently a process which at present is intermittent will become a continuous one.

The Imperial Iron and Steel Works of Japan.—The iron and steel plant which the Government of Japan is now building is situated at Kiushiu, about ten miles from Moji, near Wakamatsu. The works face a bay called Dokai. It is intended to dredge out this bay, so that there will be a fair way to the wharf now building at the works, by which vessels of about 3,000 tons burden may reach the wharves and discharge iron ore. The ore will have to be brought either from the Yangtsze, in China, or from the Kamaishi mines, in the north of Japan. There is an abundance of coal within a radius of 100 miles from the works. The ore will be carried from the wharf by electric cranes to the rear of the works, where the ore bins are placed. These bins are designed to hold ore enough to keep two blast furnaces going for two months. The blast furnaces will have a capacity of 350 tons of ore each in 24 hours, and each is calculated to produce 165 tons of pig iron in this time. The blast and roasting furnaces are well supplied with electric hoists. In fact, all over the works as many labour-saving appliances as possible have been adopted. The system is American, though the plant has all to be made in Germany. The molten metal from the furnaces will generally be transferred direct to the mixers, which are of 160 tons capacity. The total annual capacity of the works is 90,000 tons—that is, 45,000 tons each of Bessemer and open-hearth steel, for which 120,000 tons of pig iron will be required. It is proposed to roll rails of all sections and sizes, plates up to two inches thick and seven feet wide, rounds, squares, and angles of all sizes, and joists up to 12 inches high. With the exception of that for the locomotives the steam generated for driving all of the machinery will be heated by the waste gases from the different furnaces.

British Field for Motor Cars in China.—It is pointed out that in Shanghai there exists an ideal field for motor cars, though it is impossible to induce the Chinese to buy goods without having seen them first. The best way of obtaining a steady sale, it is pointed out, would be to send a first-class motor out in charge of a good salesman, so as to give practical demonstrations for which the macadamized roads in the district are eminently suitable.

A New Armour Plate.—This plate, experiments with which have recently been carried out at Shoeburyness, is made up of six inches of ordinary steel, and faced with three inches of a special composition, the nature of which is being kept a secret. A 350-lb. projectile was fired at the plate from a distance of 200 yards, black powder being used, but on investigation it was discovered that the plate was practically uninjured. The same proved to be the case after several rounds had been fired, and in some cases we are told the projectile was reduced to dust by the force of the impact. When cordite was used, however, the plate was penetrated about three inches, and in some cases pierced, but in no instance did the plate crack. As a result of two shots being fired at the plate simultaneously, and hitting it within a space of 18 in., the special composition was still unfractured. When fired at obliquely, however, the special facing split from the steel backing, a result which was somewhat unexpected, for before this course was adopted the welding of the ordinary steel plate and the special composition could not be detected.

Smelting Iron by Electricity.—The Stassano process for the production of iron and steel has been arousing some attention in this country, and we give a few descriptive particulars. The electric arc is, of course, employed, the furnace being formed by the juxtaposition of two truncated cones by their bases, a third cone of similar formation being connected with the body of the furnace thus formed, and constituting the crucible in which the fused metal collects, and which is withdrawn by means of a tap-hole. At a point somewhat above the opening of the crucible thus formed, and within the furnace itself, are two cylindrical carbon electrodes, 10 centimetres diameter and one metre in length. The minerals charged are oxides, or carbonates, the latter undergoing a preliminary calcination. They are first pulverized, and the gangue, etc., is separated as far as possible from the metallic particles by magnetic means. An analysis is made in order to determine with exactness the proportion of carbon, lime, and silica necessary to reduce the mixture and slag off the impurities during the subsequent operations, and obtain a metal of predetermined constitution. The necessary quantities of the above are then powdered and intimately mixed with the concentrated ore, 5 to 10 per cent. of tar being added. The resulting paste is submitted to a pressure of from 200 to 300 kilogrammes per cubic centimetre in a hydraulic press, and the mass thus formed is broken in a special pug-mill into pieces, these pieces forming the ultimate charge for the electric furnace. At the intense heat developed by the electric arc (3,500 degrees centigrade) the Fe_2O_3 is decomposed, forming with the carbon present CO_2, which is, itself, subsequently reduced. The CO formed escapes to the upper portions of the furnace, where it aids in the reduction of the metallic oxides, while the reduced metal, associated with more or less carbon, collects in the lower cone before mentioned. To produce one metric ton of iron or steel, from 1,600 to 1,700 kilogrammes of fuel are required, according to the carbon contents of the description used. At 19*s.* 6*d.* per ton of coke the fuel cost of producing one ton of metal is 26*s.* In the Stassano process, the energy required for one ton of metal is 3,000 horse-power-hours. This amounts to an average of 14*s.* 3*d.*, which, it is claimed, is 12*s.* 9*d.* cheaper than in the ordinary way of smelting. The cost of the preliminary operations is certainly greater than in the other processes, but this is stated to be compensated for by the lessened cost of smelting.

A New Form of Turbine.—A new turbine water wheel, by which it is claimed that power can be obtained with a less amount of friction than with machines of ordinary construction, has recently been patented. The device is provided with a tank having a walled central opening. Connected with the tank are flumes controlled by gates, which, with their stems, are made hollow, so as to reduce their weight, to permit their being readily raised and lowered, to give access to the air, and to allow this air to expand and contract with changes of temperature. Below the tank is the casing in which the turbine wheel rotates. The turbine wheel buckets have their upper ends vertically disposed and their lower ends inclined downwardly. The water is directed to the wheel from feed tubes by conductors curved at their lower edges, so that the water may impinge against the buckets at the proper angle. The feed tubes are connected with the tank, and are each provided with two cut-offs operated from the exterior by means of gears, to one of which a handle is secured. There can be little doubt that this turbine will work, but it is difficult to see in what respect there can be less friction or greater power developed in this construction than in many other well-known forms.

Compressed Air for Street Traction.—The fight for street railways may now be divided into the following divisions of attack: animal, electric (that is to say, overhead, surface, and underground contacts), steam, cable, gas, and compressed air. With regard to the latter a large amount of discussion has arisen. But it now appears that ten cars driven by compressed air are now running in New York, and the experience derived from actual operation indicates their permanency. The cars run smoothly, and, with the exception of a slight

sound from the exhaust, there is practically no noise. It is stated that, with everything equal in the matter of operating the system, there should be a decided advantage in the economy of the air cars, for the reason that there is no expense corresponding to such items as the maintenance of overhead or underground trolley, the cost of switchboards and the burning out of motors.

A Development in Locomotives.—A large locomotive has recently been turned out for the New York Central Railroad, which embodies a novel feature of boiler construction. It is well understood that the standard type of firebox as now constructed is one of the most costly features in the boiler. On account of its rectangular shape and flat sides it has to be heavily stayed to the outer shell of the boiler, and is one of the parts that call for the most careful attention and most frequent repairs. In the new locomotive a tubular, corrugated furnace, 64 inches in diameter and 11 feet 2½ inches in length, is placed eccentrically within the back of the boiler shell, which, in the neighbourhood of the furnace, is 7 feet 1⅝ inches in diameter. The corrugated furnace is supported at its front ends by sling stays which are attached at the tube sheet. At the rear the large furnace tube extends about 6 inches beyond the back face of the boiler, to which it is flanged. A brick wall, 20 inches in height, extends above the grates at a point about 30 inches to the rear of the tube sheet, the space between the brick wall and the tube sheet forming a combustion chamber. The furnace presents a heating surface of 191½ square feet, and in the 332 tubes there are 2,164½ square feet, the total heating surface therefore being no less than 2,356 square feet. There are 35·2 square feet of grate area. The total weight of the engine is 160,000 pounds, and a boiler pressure of 185 pounds to the square inch is carried. The boiler has shown excellent steaming qualities, and as compared with the standard engines of the road it marks, in this respect, a decided advance. Evidence of this was shown during a trial trip with sixty-seven empty cars, when the pressure ran up to 195 pounds, in spite of the fact that the two pop valves set at 180 pounds were blowing off strongly.

Aluminium for Shipbuilding.—Since the first aluminium launch built by Escher Wyss & Co., of Zurich, others have been constructed by Yarrow, Thornycroft, and others, and great expectations were entertained of the suitability of aluminium for torpedo boats. It has since, however, been found totally unsuitable for sea-water navigation, for not only beneath surface, but above surface, where lasting properties have been required. We notice that Lord Kelvin has lately expressed the opinion that the oxidation of aluminium by the action of sea water could be prevented by a coat of paint. Even were this possible, however, which has not yet been ascertained, the galvanic action produced by aluminium in connection with its fastenings has yet to be provided against.

An American Tool Works in England.—It is stated that the President of the Standard Pneumatic Tool Company, Chicago, has carried out the organisation of an English company, under the name of the International Pneumatic Tool Company, Limited, to make in England the full line of pneumatic tools and appliances made by the Standard Pneumatic Tool Company. The English company will build a factory at Chippenham, near Bristol, and is purchasing an outfit of American machinery. The capital of the company is £60,000, and it will have the exclusive right to manufacture and sell these tools and appliances in Great Britain, South America, Africa, India, China, and Japan.

The New Railway between the Demerara and Essequibo Rivers.—It is to be noted that by a recently enacted law in British Guiana all plant, machinery, building and other materials required for, or in connection with, the proposed railway in New Guiana, between the Demerara and Essequibo rivers in British Guiana, are entitled to free entry into that country.

Motor Car Services.—Regular services of automobiles have now been commenced in this country for the conveyance of passengers. Newcastle and Sunderland have a regular motor car service in operation, and the success which has attended the introduction in those towns is leading to a movement for providing a complete system in the Teesside district. A company is in the course of formation, and the projectors have already ordered from the Daimler Motor Company, Limited, Coventry, eight cars—two to carry 24 passengers each, and six to carry ten each. More will be ordered when the company is launched. It is proposed that they shall run between Stockton, Eaglescliffe, and Yarm, in one direction; and Middlesbrough, Southbank, and Eston, in the other.

English Engineering in Turkey.—It would appear from a recent (American) Consular Report that whilst England furnishes the greater part of material for the Turkish factories, yet Germany exceeds us in sheet indiarubber, corrugated hose, and sheet iron and steel. Small accessories, such as bolts, nuts, files, etc., come from France, being stated to be 25 per cent. cheaper than those obtained from this country. Some drilling machinery comes from Germany, and iron in bars, beams and sheets from Belgium. There is a good opening for English saw-mill machinery in the forests of Asia Minor, there being, for instance, no handsaws in Smyrna. Railway material for conveying the timber from the forest to point of deportation is also required.

International Competition and Roumanian Flour Milling.—Trade is improving in Roumania, and the flour milling industry is steadily increasing. This is emphasised by Mr. Acting Consul-General Liddel, in a report recently received at the Foreign

Office. This expansion in the flour trade has, it is stated, encouraged the erection of the largest flour-mill in Roumania in a most favourable position for exporting, right on the bank of the river in the town itself. The milling plant of 150 tons per diem capacity, as well as the triple expansion engines, are of German manufacture, the boilers British. Both British and American engineers were, says the consular report, invited to compete for the plant and motive power, but had to retire before the much more liberal credit terms offered by their German rivals. Our British flour mill engineers should make a note of this.

New Railway in Honduras.—A new railway from Belsize, British Honduras, to be extended into Guatemala is to be erected, under a concession. British Honduras is the only section of Central America that does not possess a railroad. English engineers may anticipate stringent opposition from their American confrères, who will attempt to obtain the contract for building the whole line.

Dredging of the Port of Archangelsk.—We are informed that large dredging operations will shortly be undertaken at Archangelsk, so as to render it accessible to ships of the same draught as in the Baltic and Black Sea ports. It will be also necessary to dredge the rivers Maimax and Dwina to the depth of 26 ft. (during high tide), so as to enable large steamers to pass, even during low tide. All this will necessitate large dredgers of the bucket type.

Morocco as a Virgin Field for the Engineer.—It seems that British merchants are doing well in Morocco. According to our Consul it is not necessary to urge British merchants to be more zealous and enterprising in that country. "All that can be done," he says, "they do, and their commercial position, compared to that of their rivals, is as favourable as possible." Then adds the Consul: "I have travelled over a good deal of Africa, including our Southern colonies, and never have I met so generally fertile a country as Morocco, or a climate better suited to Europeans. . . . In agricultural districts the lightly-ploughed soils yield excellent crops of all descriptions of grain and pulse. In other districts the vine flourishes under the most primitive treatment. Trees of many kinds grow wherever they are planted, cared for, and are not destroyed for fuel. But there is nothing but discouragement for any one attempting to reap advantage from these resources. Rich copper, lead, antimony, and petroleum exist, but the door to them is locked for the present to the European and native alike. There are no made roads, railways, telegraphs, canals, or harbours. Some day Morocco will be a virgin field for the engineer, who will have no predecessor's mistakes to rectify."

The Ottoman-Smyrna Railway.—This unfortunate enterprise appears likely at last to develop in a practical direction. The capital needful for its re-organization has been provided, and British engineers should keep a careful eye on this promising market for plant and machinery.

Engineering in Hayti.—Although there is a steady sea-breeze daily in Hayti from about 10 or 11 a.m. to 5 p.m., and an equally steady land-breeze from about 7 p.m. to 9 or 10 a.m., excepting during the dry season, when the land-breeze blows occasionally for several consecutive days, windmills are not used at all in the country. Now that these have been so much improved, there is little doubt that a good market for them exists in the Republic. Makers desiring further information should write to the offices of this magazine.

Openings for British Manufactures in Sofia.—A demand for sanitary appliances will shortly spring up in Sofia, as connection with the mains is to be made compulsory for every habitation in the town. Very few dwelling houses are as yet fitted with modern sanitary appliances, but new houses are springing up in every direction, and, therefore, an occasion offers which an energetic traveller, possessing a thorough colloquial knowledge of at least French and German, might well turn to account. Catalogues and price-lists in English are practically waste paper. German or Austrian automatic cisterns, complete, are sold in Sofia at prices ranging from £6 to £7.

Bright Prospects for British Machinery in Nagasaki.—A large steel foundry is about to be established near Moji, the northern port of the island of Kiusiu, but, in spite of the projected output of this enterprise, the large requirements of the prosperous and extensive shipbuilding and repairing industry of Nagasaki, of the railways throughout the island, of waterworks which will be established in the large towns, and of machinery of all kinds, will no doubt continue to require to be satisfied from abroad for many years to come.

German Machinery at the Paris Exhibition.—Germany will make a particularly big display in all the sections of the forthcoming Paris Exhibition. They will supply the electrical installations for light and power purposes all over the grounds. Siemens and Halske and Schückert will each have a dynamo giving a force equal to about 2,000 horse-power; Helios, of Cologne, will have one of 1,900 horse-power; and Lahmayer, of Frankfort-on-the-Maine, another of 1,400 horse-power. The steam engines for these dynamos will be supplied by Herr Borsig, of Berlin, the Augsburg Company, and a Nuremburg company. The crane which is to be used for transporting heavy machines in the central gallery of the Avenue de Suffren will be supplied by Flohr, of Berlin. This crane will be capable of raising 25 tons to a height

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of 12·50 metres, and it will have a range of 26 metres. In railway rolling stock, agricultural machinery and the like, the Germans will also be in very strong force.

British Engineering Trade in Mexico.—According to the report of the British Consul in Mexico, the principal branches in which British trade may find an opening are all kinds of agricultural and mining machinery and implements, and pumps and machinery for making artesian wells. There are several schemes for supplying water and water power from the rivers throughout the country, but more especially for irrigation purposes. Lightness of the machinery is a matter of great importance, on account of the duties and of the cost of transport.

Dredging in Talienwan.—The two powerful twin-screw dredging vessels, launched by William Simons & Co. Ltd., of Renfrew, for Talienwan, have completed their dredging and steaming trials with very satisfactory results. During the dredging trials, when running 18 buckets per minute, 1,050 tons of ordinary free soil were raised per hour, and when running 12 buckets per minute in harder material 450 tons of spoil were raised per hour, both results being considerably in excess of the contract requirements. The centrifugal discharge pumps on their trials dealt with and discharged on shore through their respective lengths of steel piping the full amount of dredgings raised up by the buckets. The sand suction pumps, working on a maximum depth of 40 ft., are each capable of raising at least 1,000 tons of sand per hour. During a two-hours' run on the measured mile with and against the tide a mean speed of over eight knots was obtained, being fully one knot in excess of the speed stipulated in the contract. The owners were represented at the trials by Messrs. Totshyski, Gooseff, Johnson, and Lees. The vessels were being prepared for the voyage under steam and sail to North China, to be despatched on an early date.

ELECTRICAL ENGINEERING.

A Remarkable Electrical Engineering Feat.—What is pronounced by experts the most remarkable piece of electrical engineering in the States has just been accomplished, after three years of labour and some £125,000 expended in the enterprise; that is, the Santa Ann River, which comes out of the San Bernardino mountains, has been bridled, and its power is now transmitted to Los Angeles, some 82 miles distant. Nine thousand horse power is made to propel machinery, move street cars, and to illuminate and even heat buildings in Los Angeles, besides furnishing illumination and power for several villages. The most remarkable feature in this development of the power on the Santa Ann River is the transmission of a high voltage over 80 miles of wire with so little loss of energy, the company finding, in fact, that it can send electricity of 33,000 volts, having a working efficiency of 4,000 horse-power, a distance of 83 miles, with a loss of but 10 per cent. After doing its work in the production of electrical energy, the mountain stream is gathered into a conduit and led down the mountain side for irrigation purposes.

Another Electric Incandescent Lamp.—The Desaymar lamp now being introduced into France, though claiming an economy on existing types, does not depend in this respect, like the Nernst and others, on a smaller consumption of current, but on greater photometric efficiency. The filament, in place of being simply a loop, is made to coil spirally around a vertical tube in the centre of the bulb. This tube is made of a special composition, and is said to give to the lamp a much greater illuminating power, obtained by the peculiar form of the filament. An establishment is being installed at Rueil for the manufacture of these lamps.

Aluminium Electrical Conductors.—Owing to the high price of copper an increasing amount of attention is being devoted to aluminium as a substitute for electrical conductors, more particularly for non-insulated cables. For instance, 33 miles of aluminium cable will be used by the Hartford Electric Light Company to transmit 2,000 h.p. at 10,000 volts from Tariffville to Hartford, Connecticut, U.S.A. The cable, $\frac{3}{4}$-in. in diameter, consists of seven strands, each made up of seven wires of No. 11, B. & S. gauge, and is equivalent in conductivity to a No. 0000 copper wire. It is stated that, at the present price of copper, the saving to be made by using aluminium will amount to £730 in this case. Three-phase current is to be used, and the cables, which are bare, will be strung in an equilateral triangle on two cross arms. Aluminium cable, also, is used in the recent electric installation in Northallerton, Yorkshire—the first put up in this country.

A New Fluorescent.—By extraction from a large quantity of uranium ore, E. de Haen, of List, near Hanover, has, it is stated, obtained substances which possess the properties ascribed to "radium" in an extraordinary degree. Two preparations have been made. Preparation A exhibits the properties of Becquerel rays. It excites fluorescence in a barium platinocyanide screen even across opaque substances, affects the photographic plate, makes air electrically conducting, and has an additional property not hitherto described, that of being itself strongly luminous. Preparation B possesses in general the same properties as preparation A, but the excitement of the screen is more intense, whereas the self-luminosity is feebler. In both cases the rays which produce fluorescence penetrate bodies like black cardboard more readily than they penetrate glass. Both preparations must be carefully preserved from moisture, especially the first prepara-

tion, which loses its own luminosity in a few hours when exposed to the moisture of the atmosphere. Once the luminosity is lost it is difficult to restore it.

Electric Motors in Modern Steel Works.—In the modern American steel works, electricity as a motive power is gradually taking the place formerly occupied by the smaller class of engines which were used as auxiliaries around the mills. The change from engines to motors has effected a great gain in efficiency, as the type of engine formerly used was very uneconomical, not having any cut-off and using 120 lbs. of steam per horse power per hour. The motors are usually supplied from economical power stations which generate an electrical horse-power under 20 lbs. of steam per horse power per hour, and even taking the average efficiency of the ordinary series motor as from 65 to 75 per cent., and the shunt motor from 80 to 90 per cent., it can be plainly seen that an enormous saving will be effected.

High Tension Incandescent Lamp.—It is stated that Edison has brought out a new incandescent electric lamp for high-tension currents. It is made of a mixture of rare earths, in a porous form, with carbon dust. The current, under the high pressure, leaps from particle to particle of the carbon dust. The earth used is thoria or zirconia, and the whole is dipped in a solution of acetate of thoria so as to make a coating which shall incandesce brightly when the whole filament is brought to a high temperature by the action of the current. He also makes filaments by impregnating a cotton-wool filament and carbonising it, and then thickening the coating of oxide on it.

An Electrolytic Process for the Production of Fluorine.—M. Moissan has recently devised a new process for the production of fluorine. Up to the present platinum vessels have been used for this purpose, but as they are attacked by the fluorine, this method involves a great expense. M. Moissan has for some time been carrying out experiments with this element, and has recently designed a new electrolytic apparatus, in which the containing vessel is of copper of the same form as the platinum vessels. Its volume is rather greater, thus permitting him to use a larger quantity of hydrofluoric acid, whose conductivity is increased by the addition of 60 grm. of acid fluoride of potassium. The electrodes are of platinum, but have a larger surface, and are made in the form of hollow cylinders open on one side. The mixture of hydrofluoric acid and fluoride having been freed from water, electrolysis is carried on very satisfactorily in this apparatus, and the containing vessel is not attacked. The amount of fluorine produced by this apparatus is large enough to give good results; for instance, by using a current of 15 ampères at 50 volts, M. Moissan has obtained a rate of production corresponding to five litres per hour, the experiment lasting six minutes. In a second experiment he employed a current of 20 ampères at the same voltage, and the production reached the rate of eight litres per hour. However, this second experiment cannot be carried on for any length of time, as the liquid heats excessively, in spite of the fact that the apparatus was cooled to −50° C.

New Electrical Insulators.—Recently, attempts have been made to produce insulators for aerial conductors of a coarse kind of glass—the exact composition of which is a manufacturer's secret—which do not condense any film of moisture on their surface. Experiments carried out with such insulators appear to show conclusively that they are superior to porcelain, and it is believed that they have a large field of usefulness before them.

German Electrical Plant in America.—It is interesting to notice that the Americans, though admittedly well advanced in electrical practice, are not debarred from competition in even their own country. For instance, the Swiss Oerlikon Company have been given an order to equip a large sea-power works on the coast of California, from which electrical energy is distributed to various mines. This they have done on the three-phase system with the inductor type of alternator. As the total length of the connecting lines to the various outlying mines is only 18 miles, a pressure of 3,000 volts per phase, or 5,200 volts between the line wires, was found to be ample. There are at present installed in the station two direct-coupled 500 h.p. alternators and Sulzer engines, and two smaller sets of 250 h.p. These smaller machines are rope driven. As the bulk of the load is derived from the supply of motors, and the load on these motors is variable, it has been found impossible to keep the voltage altogether sufficiently constant for lighting purposes. To supply their place for this purpose, some direct-current machines have been installed. These are driven by three-phase motors. The same device is used in one of the chief mines to obtain a steady light. Great care has been taken that the motors and transformers should be of the same capacity, so that the plant should be worked with the highest efficiency.

Is there an Opening for English Electric Work in Germany?—Most people will say not; but at the same time it is not certain that the view thus expressed is wholly conclusive. A very large number of electric plants are in course of construction, or projected, and by a proper study of local conditions by competent men, it is by no means unlikely that some profitable electrical business on certain lines might not be brought to this country.

Canal Boat Traction.—It seems strange that although innumerable systems of traction have been tried and suggested in connection with canal boats, none has proved so far entirely satisfactory or devoid of objectionable features,

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with the result that this important problem of doing away with animal power on canals still remains to a certain extent unsolved. As early as 1862 a system of canal boat towing was tried abroad, consisting of an endless cable kept in constant motion. To this the boats were attached, much resembling in this respect the well-known cable street railway. This system, as may readily be inferred, proved unsatisfactory and was soon abandoned, owing in part to the difficulty of attaching the tow rope to the moving cable as well as to the sudden jerk to which the boat was subjected in starting. Since then gas and oil engines have been tried with questionable success, owing to the difficulty of procuring an adequate supply of gas while *en route*. That electricity was better adapted to canal towage than any other form of motive power was soon recognised, and consequently numerous systems of an electrical nature were suggested and tried. The simplest method was found to be the placing on each barge of storage batteries, the current to be utilised in the driving of a small propeller through the medium of an electric motor. An arrangement of this character was given a trial in France some time ago, but was not permanently adopted owing to the difficulty of keeping the batteries charged as well as to the fact that the motion of the propeller in the waters of the canal tended to materially injure the banks through erosion. Next various methods of electrical haulage were tried. In one such system, employed to a limited extent in Belgium, a vehicle much resembling an electrically operated tricycle is made use of. This vehicle, to which a canal boat is attached by an ordinary towing rope, runs along the bank of the canal, taking its current from two overhead conductors strung by the side of the towing path. It would seem very questionable whether such a system will ever be generally adopted, as it is only natural to suppose that such a vehicle travelling over a more or less uneven tow-path would require as much power to propel itself as to draw the boat. In Germany, according to a recent issue of the *Elektrotechnische Zeitschrift*, an attempt will shortly be made to tow canal boats by means of electric locomotives running upon a narrow gauge railway constructed along the canal bank, the necessary current for operating being taken from an overhead trolley wire in the ordinary manner. Such a system should prove mechanically and electrically successful, but whether it will be financially remunerative is extremely doubtful, owing to the large outlay in money it would entail. Probably the most practical device yet brought out consists of electric motors running on cables carried on posts on the bank and to which the boats are attached by two ropes in the ordinary manner. By means of suitable wires carried on the haulage cable the motor may be controlled from the deck of the boat, which is a decided advantage.

The Marvin Electric Rock Drill.—In a recent issue of the *République Française*, M. P. Petit, a rock-drill operated by electricity or compressed air, has often been likened to a gigantic stock and centre-bit; but the comparison does not entirely hold good, because the joiner endeavours to make the hole as smooth as possible, while the rock-drill has generally to effect a breach, and therefore to dislodge the bed of rock. If, therefore, it makes too regular a hole, more labour would be required for bringing down the rock, because either the holes must be connected or the pick resorted to. It follows from this that it is often useful to have a machine capable of striking violent blows against the rock, and the bit of which, instead of simply revolving uniformly in one direction, only makes partial rotations. The problem appears to be solved, however, he continues, in a very simple and ingenious manner by the Marvin rock-drill, which is worked by electricity, so that it can be used at a considerable distance from the source of power, and yet with slight expenditure for conductors. The drill carrier consists of two parts, one, of larger diameter than the other, being magnetised and terminating in a spur pinion provided with a pawl, while round this rod is a winding of insulated wires forming a double solenoid. While reciprocating like a steam piston, the drill carrier makes a slight turn on its own axis; and the drill, thrust violently against the rock, brings away a portion thereof with each partial revolution.

MINING.

Firedamp *v.* Explosives. — In spite of the excellent work published several years ago on the subject of coal-dust explosions in coal mines, it still remains an open question whether the author accounted fully for the disasters in coal mines, whose recurrence it seems impossible to avert. A somewhat vague paragraph from our contemporary, *Engineering*, deals with the possibility of firing explosive mixtures by means of electricity. It is said that the results of experiments on the ignition of firedamp and coal-dust by means of electricity made by Herr Heise and Dr. Theim in Germany show that in general the amount of electrical energy capable, in certain circumstances, of igniting firedamp need only be small. This amount cannot be definitely fixed, however, as it depends not only on the quantity of energy, but on the mode of its application and other attendant circumstances. In any case, all visible sparks may be looked upon as dangerous. Explosions of coal-dust alone appear to be impossible of production by electricity, unless special classes of coal-dust behave differently from those tried.

American Mining Machinery.—There can be no doubt of the fact that British makers have a long way to catch up in export mining business. To quote from an American contemporary: "It is a notable fact that in South Africa, American mining machinery is the choice of the operators, and that in the face of British competition. The air compressor and the rock

drill, and other forms of specific machinery are almost exclusively American, though general machinery, boilers, &c., are British. In Western Australia the same conditions exist, though in a less positive fashion. The same may be said of British Columbia, and also of Russia, in which country mining enterprises are on the threshold of a new era. The exports of British mining machinery represent a heavy aggregate of tonnage and value, and are by no means a feeble or debilitated factor in the machine-building interests of the country. The value of exports in 1896 was in excess of £1,493,000, but in the following year it had shrunken to £718,000. In its own colonies the decline has been marked."

The Production of Coal in British India.—According to a circular which has been issued by the India Office, it appears that there were altogether in India 174 coal mines in operation last year, 158 of them being located in Bengal. The production in Bengal in 1898 exceeded 78 per cent. of the whole Indian production. The output in 1886 was 1,388,487 tons, and it has been increasing every year since that date. The industry gives employment to some 63,000 persons, and the capital invested in it by joint-stock companies amounts to Rx. 1,148,323 (paid-up): there is also a large, but unknown, investment of capital by private mine owners and by the State. The value of the output in 1898, calculated at the local wholesale selling prices, may be estimated at Rx. 1,430,467, making an average of Rs. 3·11 per ton, against Rx. 1,246,659 (Rs. 3·07 per ton) in the preceding year. Indian coal is being exported in increasing quantity, though still on a small scale, to foreign countries (mainly to Colombo and Singapore), the amount exported having risen gradually from only 53,665 tons in 1894-95 to 327,104 tons in 1898-99. The Indian railways consume it in large and increasing quantities, the consumption in 1898 being 31 per cent. of the whole production.

Opal Mining is one of the latest Australian mineral industries, the beautiful gem being abundant in New South Wales and Queensland. The Devonian rocks, in which the gem is found, occur to the east and north-east of the older silurian metalliferous formations, and may in time be found to reach as far north as the Queensland border. At the present day the principal opal-winning centre is White Cliffs, where the gem has been found in highly payable quantities and of the richest quality, within a radius of ten miles, and a population of 1,500, or thereabouts, is settled there.

British *v.* American Machinery in South Africa.—There is no getting away from the fact that British-made mining machinery has by no means the complete hold upon the South African demand that is its due. The correspondent of a contemporary says: "On the deep-level gold mines there is a predominance of American machinery, but this is mainly due to the nationality of the engineers and managers. There seems to be no doubt that for heavy mining work British-built plant is the more durable and trustworthy, and it can be continuously worked up to its full guaranteed power with less fear of a breakdown than the American plant. At some mines under American direction I am afraid that British machinery does not get a fair chance, and I have heard, for instance, of a 16-drill compressor, of English make, which was worked up to a capacity of twenty-four drills, and then triumphantly produced as giving inferior results to an American engine of the same nominal power that was never called upon to drive more than fourteen drills."

MARINE ENGINEERING AND SHIPBUILDING.

The Suez Canal.—The depression which was formerly noted in connection with Suez Canal traffic seems to have been wholly dispelled. At all events, it has been shown officially that last year's receipts amounted to 87,906,000 fr.—an increase of 12,209,000 fr. as compared with the returns for 1897, of which 10,855,000 fr. arose from commercial traffic alone. While business has thus increased economy has been effected to the extent of 250,000 fr. in the working expenses. To new buildings and plant, including the recently built tug and the new marine dredger, a sum of 2,851,000 fr. has been allocated. Last year 3,503 vessels, of 9,238,000 tons burden, passed through the Canal, the average duration of transit being 15 hours 43 minutes. Of these 2,295 carried the British flag, Germany following with 356, France with 221, Holland 193, Austria 85, Italy 74, Turkey 54, Spain 49, Russia 48, Norway 47, Japan 46, Egypt 10, Denmark 8, China 4, Portugal 3, Sweden 2, Greece 2, and Roumania and the Argentine Republic 1 each.

Ice-breaking in Polar Regions.—The Russian ice-breaking vessel, *Ermack*, the largest of its kind in the world, has returned to the Tyne, where she was built, after what is stated to have been a most successful voyage in Polar seas. The *Ermack* (8,000 tons displacement, 10,000 tons h.-p.) was built by Messrs. Armstrong, Whitworth, and Co., at their Walker Yard, to the order of the Russian Government, and launched early in 1899. Her mission is to break up the ice of the Baltic, and also that of the Kara Sea, so as to give ships access to the Russian ports and Siberian rivers at times which have hitherto been closed to them through the rigours of winter. Last March she entered the frozen up part of Cronstadt with comparative ease, and then going to Revel liberated thirty-three vessels of the value sterling of 1½ millions, and some of which were in great danger. Then, returning to Cronstadt and St. Petersburg, she opened out the way for the entry of forty steamers several weeks before the ordinary time. This work proved the commercial value of the *Ermack*, but all the same it was

deemed wise to subject her to more severe tests. Accordingly her commander, Vice-Admiral Makaroff, of the Imperial Russian Navy, took her to the Polar Sea some six weeks ago, calling at Advent Bay, Spitzbergen, *en route*. Polar ice was encountered in lat. 80 deg. 15 min., and for over a month the *Ermack* was put to a very stiff trial amongst this. Some of the plain ice was 14 ft. thick, and the pack or ridge rose to a height of 18 ft. on the surface, and was ascertained by careful measurement to be as deep as seven fathoms in places. The *Ermack* behaved splendidly, and travelled through some 230 miles of such obstacles at an average speed of three to four knots per hour.

H.M.S. "Canopus."—The fact that a new *Canopus* has been added to our battleships recalls some interesting comparisons indicative of our warshipbuilding progress. The first *Canopus* was built at Toulon, launched during the spring of 1797, and named *Franklin* in honour of that notable American. She was considered the finest two-decker in the world. The length of her lower deck was 193 ft. 10 in., her extreme breadth 51 ft. 6¾ in., and tonnage, by measurement, 2,257, exceeding that of our famous *Victory*. Though nominally an eighty-gun ship, the *Canopus* was armed with 92 pieces of ordnance. The broadside of the modern *Canopus* will be no less than 4,000 lb., thus more than tripling the weight of her predecessor. The *Franklin* was commissioned by her owners, and, bearing the flag of Rear-Admiral Blanquet, sailed from Toulon in 1798 among the fleet which escorted the force under Napoleon to Egypt. When Nelson attacked the French armada in Aboukir Bay, the *Franklin* was hotly engaged, and fought till her main and mizen-masts came down by the board. Then having scarcely a gun left in condition to use, and with about 400 of her men killed or wounded, she struck her flag, thus becoming the finest trophy of the battle of the Nile. The prize was bought by the Admiralty for our own navy, but received the new designation *Canopus*, the ancient name of Aboukir. She remained in commission as late as 1874, next became a receiving-hulk at Devonport, and disappeared from the rolls when she was ninety years old. A naval historian wrote of her as a type of ship "that would never be out of vogue while a navy is worth preserving"; but that historian prophesied without knowing, as the new *Canopus* sufficiently demonstrates.

MISCELLANEOUS.

British *v.* Hungarian Flour.—We are glad to note that efforts are about to be made in order to ascertain whether flour cannot be produced in this country equal to the Hungarian product. The proprietors of the *Miller* are offering a prize, value 50 guineas, for competition at the forthcoming Bakers' Exhibition, Islington, for the best sample of flour manufactured entirely in any mill in the United Kingdom from a mixture containing any wheat except Hungarian, with certain provisos.

Blasting in Excelsis.—The Furnace district at Lochfyneside, in Argyleshire, has long been noted for the abnormally large blasts which take place in the quarries there. Another monster blast took place quite recently there and proved highly successful, reflecting credit on Mr. Nicol, the manager, who supervised the whole work of the construction of the mines. There were four tons of powder used, and it was estimated that some 30,000 tons of rock were dislodged by the blast. The height of the rock over the mines was 75 ft. and the distance from front to back 40 ft.

New Automatic Typewriting Machine.—An addition has been made to the already numerous varieties of typewriters by the Granville Automatic Typewriter Syndicate, Limited, of 54 and 55, Cornhill, London, E.C. It embodies some changes on existing machines, principally with the view of facilitating the movement of the platen or roller with the manuscript paper, all motion being controlled by keys placed on either side of the usual letter keys. This is the explanation of the term "automatic," which is somewhat misleading. A key on either side working a series of bellcrank levers brings the platen and the manuscript paper back to its starting point, at the same time rotating the platen a distance equal to that between the lines. The return of the platen winds a spring, which can be released by another key whereby the platen can be moved to any position. A third key, operating a ratchet and pawl arrangement on the end of the roller, enables the typewriter to rotate the platen at will, so that he can print a column of figures, and rule vertical as well as horizontal lines, the latter by traversing of the long roller.

Metallic Alloys and Corrosion.—The corrosion-resisting powers of metallic alloys is a matter of considerable importance in marine engineering, and some interesting experiments have recently been carried out at Kiel. The tests were made by cutting off twelve specimens of the metal to be tested, of which three were kept as "witnesses," whilst the other nine were placed in salt water. At the end of eight months three of the latter were withdrawn and compared with the "witnesses." Eight months later a second set was withdrawn and a fresh comparison made, those then left being taken out after the lapse of a third period of eight months. The metal tested included alloys of copper rich in zinc, bronzes containing little zinc, bronzes containing no zinc, pure aluminium bronzes, and finally bronzes containing aluminium and zinc or zinc and iron. The latter in particular showed remarkable resistance to the corrosive powers of sea water, being practically untouched at the end of a two years' immersion. The alloys containing zinc, however, gave much less favourable results. The copper-tin alloys and copper-aluminium alloys and the iron bronzes resisted perfectly when immersed in sea water in contact with iron. The bronzes containing iron, when placed in contact with those of tin, showed a loss by corrosion.

A New Steam Packing.—An addition to the list of steam and hydraulic packings has, we learn, been made by Messrs. R. and J. Rankin & Co., of the Union Foundry, Manchester-street, Liverpool. It comes as the result of a series of successful experiments, carried out with a view to producing a packing for general use, and more especially designed for meeting the requirements of the present-day high steam pressure. A fault with many packings is that if the outer covering gives way, the whole is rendered useless; whilst in some packings, if one strand has worn through, the other strands with which it is plaited are released, and the packing becomes uneven, and thus constitutes a hindrance instead of an aid to the running of the machinery. The makers, for obvious reasons, do not care to say much as to the composition of this packing, but it has been stated to be a mixture of asbestos with other important ingredients, including a lasting lubricant and another substance, upon which its success largely depends.

A Sanitary Dust Cart.—The dust cart has become such a conventional vehicle that any radical improvement upon its typical construction seemed out of the question. That improvements upon sanitary, as well as transport, grounds was possible, however, impressed itself upon the London County Council, with the result that an exhibition has been held of the competitive models and designs sent in answer to the invitation issued by the County Council, which also offered a premium of £25 for the best design. The object of the Council is the improvement of the system of dust collection at present in use, and the abrogation of the nuisance caused by the dust being blown about the streets as it is from the carts at present in use. Out of 53 models and 375 plans sent in the prize has been awarded to Messrs. Glover and Sons, of Warwick, for a very effective van. This vehicle has four sliding covers, with longitudinal and transverse wind guards, raised eight inches above the slides. Another advantage of the new dust van is that it is easily tipped and cleared by means of a special screw arrangement, and the front is fitted with a driving-box for the dustmen, obviating their sitting in the cart or on the open covers, while it serves as a receptacle for tools and disinfectants. The judge in the competition was Mr. Henry Law, chairman of the Sanitary Institute.

A New Celluloid.—A new industrial material has been produced under the title of acetate of cellulose. It is stated to resemble nitro-cellulose in character, but is non-explosive and will withstand a high temperature without decomposition. It is soluble in chloroform and nitro benzine, but not in alcohol, ether, or acetone. As an electrical insulator acetate of cellulose is said to have high value, its resistance being higher than that of india-rubber or gutta-percha. It has been found useful in many places where mica is now employed, and it may take the place of that mineral to a considerable extent.

Threatened Displacement of British Trade in Hawaii.—What is stated as the first set of steam ploughs of the kind to be made by an American firm has recently been landed in Hawaii. Steam ploughs heretofore made in the United States have not been of the cable description, but worked by the engine hauling the ploughs over the land. These new ploughs were made by the O. S. Kelley Company, of Springfield, Ohio. Heretofore, all the steam ploughs used in Hawaii came from Scotland, because they were cheaper and also because American manufacturers did not make the kind employed there. The ploughs cost over £4,000 per set, and were delivered in forty days less than if ordered from Scotland. It is estimated that during the next three years some twenty or thirty sets of ploughs will be required for the new plantations. They will all be bought in the United States if the ones just received prove equal to those made in Scotland.

British Paper in Australia.—We notice in a recent number of a prominent American journal, *The American Manufacturer*, the following surprising statements. They are represented as the statements of Mr. Scott Cranston, of Cape Town. Referring to the supply of paper and printing material in South Africa and Australia, he states as reported:—"In the future America will directly supply practically all the requirements of the Colonies . . . Five years ago, the Australian paper trade was monopolised by three English firms, namely, Lloyds', Spicer Bros., and Spicer and Sons. The American competition has got so aggressive that Lloyds', the largest concern of the trio, have actually closed their Australian office, which was established there for nearly twenty years. I met their representative at Niagara, busy purchasing paper which will be resold as an English production."——It is hardly necessary to say, that however the facts may be, the latter statement is a most unwarrantable one to make, and to our knowledge, without the least foundation.

A Simultaneous Colour-Printing Machine.—The Orloff colour-printing machine embodies a complete departure from all existent ideas. We have seen a number of specimens exemplifying the work of the machine as employed by the Russian Government, which are exceedingly interesting as quite unlike anything produced under present practice. The colours are all printed in one single operation, the number of finished impressions being at the rate of about 1,000 per hour.

The Supply of Camphor.—A camphor monopoly is being established in Formosa, and in its expectation, proceedings have taken place which threaten a serious reduction in the future export. Those who have obtained licences to manufacture camphor, but have not yet fixed their apparatus, have commenced operations in the camphor forests, while many Japanese and Formosans are

alleged to be engaged in secret manufacture, with the result of irregular cutting of camphor trees and the production of a camphor of inferior quality. The object of the Government in establishing the monopoly in Formosa was to increase the revenue and at the same time preserve the camphor trees and maintain a good quality of camphor, so as to preserve this source of wealth, but it appears probable that its more immediate effect will be to stimulate the production of the artificial substitute.

Caution to Traders with Greece.—It seems to be a settled natural law that a period of abnormal activity should follow every war. The late Græco-Turkish war was no exception to this rule, and the extraordinary revival of trade and commerce in Greece after the war has led to the appearance of a number of new agents and shipping firms at Athens, Patras, and other cities. This is not, however, it would seem, an all-round blessing, inasmuch as in a recent *communiqué* to its members, the Association of Berlin Merchants and Manufacturers points out, upon what it states to be trustworthy information, that most of those to whom we have referred are young and inexperienced persons, or individuals of doubtful character and of various nationalities, whose only object is to make a living at the expense of foreign traders. In this way they not only defraud the latter, but injure the prospects of foreign commerce with Greece. Therefore the above-mentioned association warns everyone to exercise the greatest care in dealing with Greek firms or persons of any other nationality established in Greece. It is recommended that applications for agencies, &c., should only be entertained after thorough inquiries have been made, through the local Consul or otherwise.

The Glasgow Exhibition of 1901.—Rapid progress is being made with the preliminary arrangements for this exhibition, which promises to be a very fine show. The Machinery and Electric Lighting Committee of the Exhibition, have, we hear, agreed to accept as exhibits for producing steam for electric lighting and motive power, the following:—Lancashire boilers from Messrs. Penman & Co., Glasgow; water-tube boilers from Messrs. Babcock and Wilcox, Limited, Glasgow; Messrs. Stirling & Co., Limited, Edinburgh; Messrs. Weir, Limited, Cathcart, Glasgow; Mr. W. E. Berry, Manchester; and Messrs. Penman & Co., Glasgow. It is estimated that the total power required will be about 5,000 h.p.

Flattering to British Fire Protection Methods.—Opinions differ as to which is the world's premier fire brigade, but it is evident that that of London will take a lot of beating. It is flattering to the London system any how to learn that St. Petersburg now boasts of a Pan-Russian Fire Protection Society, organised on lines similar to those of the British Fire Prevention Committee, although fire brigade matters, perhaps, receive more attention there than with the English institution, which deals primarily with the prevention of fire from the construction and technical point of view. The Russian society is, however, also now to follow the London example of creating a fire-testing station, and Prince Alexander Levoff, its president, has already gone so far as to present the necessary site and building. The scheme for this station is the result of Mr. E. O. Sachs' recent visit to St. Petersburg, and its organisation is part of his project for a series of stations in the Continental capitals, to be worked on lines identical with those adopted in London. Whilst the foreign stations will attend solely to matters of local interest, the station at Regent's Park will deal with matters of international importance, and serve as the centre. At St. Petersburg, for instance, attention will almost entirely have to be given to approved methods of construction in the villages, where safer materials will have to take the place of thatch and matching. The annual destruction of villages in Russia, is very serious, and the national yearly fire loss, about 7 millions sterling. Mr. Sachs expects that by a systematic organisation of this kind, and a systematic international mode of procedure, with due regard to special local requirements, combined action in fire prevention will be arrived at on the same lines as we have international movements in sanitary and hygienic matters.

A Special Varnish for Aluminium.—What is described as an excellent varnish for aluminium is described in a French contemporary, as per the following details. There is dissolved, preferably in an enamelled basin, 100 parts of gum arabic in 300 parts of liquid ammonia. This is heated about an hour and then allowed to cool, when the varnish is ready for use. The aluminium to be coated is carefully cleansed with soda and allowed to dry in a warm place, and after having covered its surface with the varnish it is heated in a furnace to a temperature of 300 degrees centigrade for a short time. After covering aluminium with a coating of this protective varnish it can be painted and polished without any fear of scaling off or cracking.

Entry of British Goods into Russia.—The Russian Customs authorities have notified all foreign railways that in future no cases, packets, &c., will be received in which the signs and numbers are made not on cases themselves but on paper tags attached to them. Such cases will be confiscated, as the custom-house authorities consider them as goods without documents. An exception is made for empty sacks.

The Production of Amber.—Amber is found all along the Prussian shores of the Baltic, but principally in the peninsula of Samland. All amber, found everywhere, is state property, but the State cannot mine amber without the permission of the owner of the ground. Before the beginning of the present century, digging was the

only means employed for obtaining amber. It was done in an irregular manner, and in 1862 dredging was practised. This was continued until 1890, when mining by means of shafts was also resorted to; diving has also been practised with great success. Amber occurs in the so-called blue earth, a sandy clay with many grains of quartz and granite In the dry state the earth is green, and when it is wet it becomes almost black. The blue earth is washed with water, the big lumps being reduced with the help of mallets, and passed over sieves, and the slime is returned to the sea. The shafts have a depth of from 30 to 60 feet, and further inland they may be double this depth. One mine has nearly a thousand employés. The inferior pieces of amber are made into what is called "ambroid." The pieces are washed and dried, coated on the outside with some chemical, and are then moulded with the aid of heat and pressure.

A New Explosive.—Thorite is the name of a new high explosive adapted for the bursting charge of shells fired from ordinary guns. In a recent test it is said that a 7-in. 132-lb. shell was loaded with 4 lbs. of thorite, and then exploded by electricity in a 10-ft. square steel enclosure. It was estimated that the fragments numbered 20,000. Thorite-charged 10-in. shells have been fired through a 4½-in. Harveyised steel plate without exploding.

Trade between United States and Japan.—It is stated that the exports from the United States to Japan have increased at a greater ratio than those of any other country. The United States occupies second place and will soon outdistance Great Britain, which leads. In 1881, the United States exported to Japan goods to the value of 1,781,108 yen, which was 5·72 per cent. of the total imports. Great Britain exported to Japan for the same year merchandise valued at 16,364,740 yen, or 52·57 per cent. of the total imported into the Islands. The United States has made phenomenal strides in Japanese trade in the interim, and in 1898 the exports amounted to 40,001,097 yen, or 14·57 per cent. of the total imports, as against 62,707,572 yen from the United Kingdom, or 22·84 per cent. of total imports into Japan.

A New Textile Plant.—It is stated that some years ago an explorer in Asia discovered a plant of silken fibre, used by the Turkomans for the manufacture of withes and cord, and by the Canagues for woven goods. This plant, known as the Apocynum venetum, is a sort of bush with slender cylindrical branches, sometimes six feet high. It grows in Europe, Siberia, Asia Minor, the North of India, Manchuria, and Japan; but it is not cultivated, and, up to the present, has been used only in the natural state. The branches die yearly, and in the spring new shoots start horizontally from the roots. It flourishes best where the land is under water during a part of the year, notably in the neighbourhood of rivers that overflow at stated periods. Under favourable conditions, the Apocynum develops quickly, and in a short time the branches form a thick growth, almost like a miniature wood. The best fibre is obtained by cutting the branches in midsummer, when the plant has obtained its full growth. It grows luxuriantly on the banks of the Amu Darya and the Ali, and the natives of these regions have used the fibre for many years for cord and fish nets. They value it not only for its great strength, but also because no care is required in its cultivation. In 1895 the Russian Government began to use it in the manufacture of bank notes, and since then the plant has been cultivated at Poltava. The results obtained thus far are considered excellent, and the time is doubtless near when the Apocynum venetum will take an important place in the textile market.

Wood Flour *v.* Kieselguhr.—Although wood flour is considered inferior to infusorial earth for the manufacture of dynamite, yet its comparative cheapness has caused it in some cases to be employed for this purpose. The material is obtained by grinding saw-dust to a fine flour. Wood flour is also used in the manufacture of linoleum, instead of cork powder.

Paper and Pulp Mills and other Industries in Canada.—Pulp and paper developments in Canada are reaching an enormous scale. Large new mills will soon be begun at Keewatin, near Rat Portage, in northern Ontario. The projector, Mr. Mather, who now lives at Ottawa, built a saw mill at Keewatin about twenty years ago, before the Canadian Pacific Railway was run through that section—the mining centre of the Lake of the Woods district. He followed this with the largest flouring mill in Canada, with the Keewatin gold reduction works, and the Keewatin dam. This dam is now the cause of the pulp and paper mills. It is very large, and is situated in the centre of the district from which Michigan and Wisconsin paper mills have been drawing their supply of spruce logs. It is also much closer to Winnipeg and the Western country, where there are no paper mills, than the Sault or Ottawa, and even closer than Sturgeon Falls, where new mills are being erected. Mills at Rat Portage will be nearer to the West than any other mills in Canada, and it is expected that they will command a large share of the Western market. The Rat Portage district has great possibilities. Including Keewatin, it has nearly 9,000 inhabitants, and the largest saw mills in Ontario. It is estimated that the new pulp and paper mills will cost $2,500,000, and will employ 1,000 hands. The town is situated on an inland lake now navigable for 250 miles. Besides the forests there are marvellous stores of gold, silver, copper, nickel, and iron on every hand. Mr. Mather also proposes to utilize his dam for the purpose of supplying electricity to Rat Portage and Winnipeg. The latter city is only 130 miles distant, and has only one other possible water power, and that has never been developed. It is thought that within two

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years Rat Portage will be supplying Winnipeg with 5,000 horse-power. The development of Canadian water power and the erection of immense paper mills was hardly thought of ten years ago, while now the E. B. Eddy Company's mills at Hull, the huge mills at Grand Mere, new mills in the maritime provinces, huge mills at the Sault, a large mill in course of erection at Sturgeon Falls, and the large group about to be started at Rat Portage, bear evidence to the rapidity of the age. They also point to an early date for immense exportations of pulp fibre and of paper.

English Cycles in Bangkok.—Bicycling is of recent growth in Siam, but has already attained considerable popularity, which has been assisted by the opening of several new roads in Bangkok. American machines found a good sale, partly on account of their lightness, but more because they could be sold at cheaper rates. They were mostly old patterns of three or four years ago which could not be sold elsewhere. It is said that they were not found entirely satisfactory, and that complaints are made of their getting out of order. It may be hoped that now his Majesty the King, and many of the princes and nobles cycle, a demand for a better class of machine may arise and the English-built cycle be more in evidence. As the Siamese are a small, light race, heavy machines would be out of place. At the same time the roughness of most of the roads requires a certain amount of strength in them. Of course there is no guarantee that the present turn for cycling will last, as such fancies are liable to pass, especially in Siam.

A Story from San Francisco.—A recent Consular Report relates to the great falling off in the importation of British Portland cement, and relates the following, which has a suspicious similarity to a story we have heard before. "Several years ago," say the Consul, "one of the largest dealers in cement here discovered that a new quality had been introduced from the Continent of Europe, and that it was meeting with the approval of consumers, on account of its greater fineness and somewhat lower price. It was to the advantage and convenience of this merchant to continue to take his supplies from England, his firm having its only European establishment there. He therefore notified the manufacturer of the danger to their joint interests, and recommended them to sift with a finer mesh and modify their price a little. Failing to make any impression by letter, he crossed the Atlantic and laid the state of affairs before them personally. But they remained, notwithstanding all his efforts, perfectly convinced that they were making as fine a cement as the world had any need of, and that it was good value for the money they asked. So, like a prudent man of business, he carried his firm's patronage elsewhere, and is now importing from Germany only. When this bit of commercial history was related to me, it evoked the following comment from a neighbour:—'It is your manufacturers you Britishers want to educate rather than your merchants,' and I reminded myself that I have now been, as a Consular representative, in three countries in which I have seen importers transfer custom to the Continent of Europe because the producers of the United Kingdom are too slow in adapting their goods to changing markets."

Our attention has been called to one or two points referring to "Industrial Progress" in our last issue. Mr. R. W. Ostell Prosser, of Blaydon-on-Tyne, says:—"In this month's issue of your excellent Magazine allow me to point out what I believe to be a slight error. On page 389 you refer to Sir Frederick Bramwell's paper on "The Transmission of energy by a partially rarified atmosphere," as being read before the Inst. of Civil Engineers. Should it not be the Inst. of Mechanical Engineers? as I was present at the reading of a paper by him on that subject on the 25th July, at the summer meeting of the Inst. Mechan. Engineers, at Plymouth." Messrs. J. E. Hartley & Son, of St. Paul's Square, Birmingham, say:—"Excuse us for pointing out that the paragraph under above heading on page 381, October issue, is a little misleading to the practical plater. Nine-tenths of nickel platers are depositing on steel and iron in connection with the cycle industry. Their baths never become acid in use, the tendency is to become alkaline. They should be *slightly* acid. The most important item in the paragraph is in the last two lines. If it read "Baths that have become alkaline should be *slightly acidulated* with dilute sulphuric acid" it would be helpful. The baths should not be *neutralised*.

Several Correspondents have questioned the accuracy of some figures we published in our last issue concerning the gold production of Australia. We much regret the error pointed out, for which we are unable to account. The following communication from the Agent-General of Queensland, we feel it incumbent on us to print in full.

"The attention of the Agent-General has been called to a serious mistake which appears in the October issue of your magazine. On page 384 of that number, under the heading of 'Gold Production in Australasia.' Queensland's output for the first six months of the years 1898 and 1899 is given as 47 ounces and 70 ounces respectively, whereas the figures should be:—First six months of 1898, 427,661 ounces; 1899, 451,461 ounces. I am, therefore, to request that you will be good enough to have the statement corrected in your next issue."—CHAS. S. DICKEN, Secretary.

The Editor of FEILDEN'S MAGAZINE

Will be pleased to consider Literary Contributions dealing with subjects within the purview of this Magazine, and to make satisfactory arrangements with Contributors if MSS. be accepted for publication. High-class Engravings from photos and drawings will be prepared free of cost to the writer.

BRITISH.

Engineering: September 15th, 1899.

Notes from Neuchwang.
The Lillie Evaporator.
The Institution of Electrical Engineers in Switzerland.
Iron Centring used in Constructing the Wienfluss Boulevard, Vienna.
Self-propelled Steam Fire Engine.
Four-spindle Drilling Machine.
Box-Nailing Machine.
Italian Armoured Cruiser.
Ten-wheeled Passenger Locomotive.
Eight-inch Automatic Lathe Chuck.
Vanderbilt Locomotive.

In a leading article on the new generating plant for the City and South London Railway, *Engineering* refers to a novel method of construction employed for the flywheels of horizontal engines. The flywheels, in view of the great variation in speed that would possibly result from a possible short circuit, are of unusual design. In place of spokes, the rim and hub, both of which are of cast iron, are connected by discs of boiler plate. The strength of this construction is such that though 22 ft. in diameter, the wheel, as stated, could be brought to rest from its normal speed within a single revolution without any risk of bursting.

Engineering: September 22nd, 1899.

American Competition.
The 34-storey Park New Building, New York.
Electric Installations, Park New Building.
Stettener Maschinenbau Actien-Gesellschaft "Vulcan."
Steam Motor Cars.
Hill's Railway Wagon Coupling.

In this issue *Engineering* announces a step which should be attended with interesting, and possibly important, results. Our contemporary has, as it states, "invited a number of prominent Americans and Englishmen" to express their views on the already discussed subject of American competition with British industries. The first of the series, by Col. E. A. Stevens, appears in the same number. We cannot say there is anything in Colonel Stevens' deliverance that is not already pretty generally known. It is, however, interesting to note, that though working from an entirely different and, indeed, opposed, standpoint to that of Tom Mann, whose ideas on the same matter were expressed in our last issue, Colonel Stevens, a large employer of labour, comes to exactly the same conclusions as those of the late leader of trades unionism. Colonel Stevens says:—

> There is as a rule, a marked difference in the method of discipline in Great Britain and the United States. In the latter there is less demand for blind and unreasoning obedience, a greater reliance on the subordinate's understanding of the need of obedience, and consequently more intelligent action on his part. Suggested improvements by mechanics, and even by apprentices, are a daily thing with us; they are welcomed and encouraged, and are often of great value. I understand that, as a rule, in England, such suggestions are not eagerly welcomed.
>
> Let us go a little into details. I will suppose that a new design of machine is to be given out in my shop. When the fact becomes generally known, the entire establishment, from office-boys to superintendent, takes interest in the matter; and there is no hesitancy on the part of the employés to suggest modifications of design or alterations in processes of manufacture. Most suggestions from the workmen are in the direction of cheapening the work, or of simplifying the various mechanical operations. It must be noticed that the time required for any operation is generally known; the reason for this is plain, as the workman sees that if he produces a piece of work more quickly than his fellow-workman, his chance of an increase of pay is good—in fact, a sure thing—and he prides himself on his superiority. Many American workmen will notify their foreman that they will run out of a job in an hour or so, thus making the foreman's work much easier. This illustrates the striking thing about an American workman: his intense interest in his particular part of the work in hand. He is very sensitive as to his reputation, and if a part made by him does not fit, ninety times out of a hundred he will discover the reason for the mistake; and if it can be laid to any tool, he will report it. The tool-box of a good American workman is probably never worth less than 50 dols.

Engineering: September 29th, 1899.

American Competition. II.
Machine Tool Works of Ludwig Loewe & Co., Berlin.
The Design of Rotary Converters.
Goliath Crane at Dover Harbour Works.
Turret Lathe and Opening Die.
Express Passenger Locomotive for the Great Central Railway.
Locomotive Boiler.
Railway Viaducts in Cornwall—Old and New.

The second article on "American Competition," written by Mr. George Howell, once a well-known labour leader, appears in this issue. It cannot be said that Mr. Howell has added a great deal to existing knowledge on the question, the chief characteristic of his communication being a general vagueness of tone that is discernible in it throughout. Mr. Howell, in one part of his article, says:

> That labour, or, in other words, the British workman, is not altogether blameless as regards the extent of foreign competition is generally admitted; to what extent is a matter of opinion. What is said is that, in

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cases where machinery is not opposed, the workmen try to limit the speed, or otherwise prevent machines from yielding the amount of work that they might reasonably give. If it is a question of danger, they have a right to a definite voice in their own defence. If, however, their object is to lessen production, their action is not so clear. At the time of the engineers' dispute the great complaint of the employers was that the men tried to limit the output in a way disastrous to the employer, and not beneficial to the men: as illustrated by the demand for one man to one machine, when it was said that he could easily attend to two, or perhaps three, according to circumstances and the nature of the work. It is to be hoped that this question is now set at rest, or is at least relegated to conciliatory negotiation. A liberal policy on both sides ought to bring about friendly mutual relations.

The limitation of output has always been a sore question, and trade unions have had to bear a large amount of vituperation on that account. Some of the old stories have exploded; they were not true. Still, it is well known that in some cases they have tried and do still try to regulate production, though it is doubtful whether any trade union rules exist in that sense. A liberal interpretation of the well-known demand for a fair day's wage for a fair day's work ought to settle the matter. It has a moral side as well as an economic side; it should mean a fair day's work for a fair day's wage. In reality, wage is a subsidiary matter, in a certain sense. The real question is, What is a fair day's work worth to the employer? Then it becomes a matter of calculation, together with cost of plant, of materials, interest on capital, and profit to the employer. It is the uncertainty of labour which is the difficulty. It is said that an employer can estimate to a nicety the cost of materials, of plant, and all other outlay, but cannot always be certain about the wages bill, especially if the undertaking be a large one, likely to last for some time. No doubt it is a difficulty, and it becomes greater if the output be lessened, and wages increased at the same time. The employer has to face advances in the prices of material also, but he is often able to protect himself by long contracts in case of fluctuations in prices. He is not able to do this in the case of labour, at least not under existing conditions, except where a sliding scale is available, as in the iron and steel trades. But sliding scales are not suitable in all cases.

Engineering: October 6th, 1899.

American Competition. III.
Messrs. Loewe's Machine-Tool Works, Berlin. II.
Snoqualmie Falls Electric Power Plant.
The Waverley Station, Edinburgh.
Windlass and Capstan Gear of R.M.S. "Oceanic."

In the continuation of the series of articles upon "American Competition," Mr. William Kent, an American technical journalist, calls attention to what he conceives to be the future of American industrial competition. He says:—

> The American competition in the world's markets for manufactured goods is not a temporary matter. It is bound to increase, and the next time there is a depression in trade in the home market in America, it will attain a magnitude and an intensity which few can imagine. . . .
>
> The labour question, it seems, therefore, is the greatest factor in the great problem of England's meeting American competition. It cannot be solved by reducing the daily wage of labour. It must be solved by the owner providing the machinery, and by the workman using that machinery to produce double the quantity of work that he has done heretofore. This plan affords the only hope of the workman's having his daily wages increased as they should be, and of England's holding the place her geographical position and natural resources entitle her to in the world's markets.

The Engineer: September 15th, 1899.

The Laws of Profit.
United States Competition in the Locomotive Export Trade.
Paris Exhibition of 1900.
Cross Compound Engines (New York).
Hydraulic Jib Crane.
New York Water Supply.
White Star Liner "Oceanic."
Channel Steamer "Mabel Grace."
Pipe-facing and Boring Machine.
Cantilever Bridge, St. John's River.
Hydraulic Working Valve.
Ball Mill.

There is an interesting letter in this issue of the *Engineer* dealing with the future of aluminium in India. It seems extremely probable that in the near future we shall have an entirely new industry in India founded on a most interesting basis. The writer, at considerable length, goes into the employment of aluminium by the natives for the construction of domestic utensils, and makes the extraordinary assertion that these can be produced by indigenous hand labour far cheaper than by machinery. The writer in effect says:—

> It is a matter of no small importance in the industrial development of India to find that in Madras, with properly organised hand labour, it is possible to meet the requirements of the Army (for utensils) at from two-thirds to four-fifths of the lowest rates tendered by European firms who perforce employ machinery. For other classes of work the difference is even greater. Lately we have sent to England a large number of samples of work which cannot be easily turned out by machinery, and it is believed that the difference in price is sufficiently great to render it possible to export certain classes of goods to England and other countries where skilled labour commands ten times the wages it does in Madras.

The Engineer: September 22nd, 1899.

The Problem of Struts with Lateral Loads.
Naval War Game in Russian Navy.
Six-coupled Express Engine.
Largest Dock in Germany.
Progress of the Ordnance Survey.
An Old Railway Time Table.
Twin-Screw Cunard Steamship "Ivernia."
Failure of Canal Bank at Dudley Port.
First-class Japanese Cruiser "Idzumo."
Electrically-driven Shaft Lathe.
Taking Steamers by Inland Route to the Caspian Sea.
Electricity in American Mines.
Star Drill Forging Machine.

The Engineer: September 29th, 1899.

United States Competition in the Locomotive Export Trade. II.
Marine Engineering and Shipbuilding on the Thames.
First-class Battleship "London."
Mechanical Traction on Canals.
Air-Compressor, Creston Mine, Colorado.
Tandem Hoisting Engines, Chihuahua Mines, Mexico.
U.S. Battleships "Kearsage" and "Kentucky."
Coulthard's Triple-Expansion Engine.
Morris's Climax Water-tube Steam Boiler.

The Engineer: October 6th, 1899.

Thermal Efficiency of Steam Engines.
Painting Locomotive Engines.
Development of the Arch Principle.
Electric Generating Engines, Henrichsburg Canal Lift.
The Lake Submarine Boat.
The Winter Train Services.
The Alaskan Railway.
Electrical Works at Grimsby.
A Customs Union between Germany and Holland.
White Pass and Yukon Railway.
Vertical Cross Turret Lathe.
Express Passenger Engine, Great Northern Railway of Ireland.

The Electrical Review: Sept. 15th, 1899.

Indispensable Accessories of Electric Traction.
Installation of Steam Boilers.
Over-Compounding Dynamos.
The Lighting of Lynn.
Electric Lighting (Clauses) Act, 1899.
Stresses in Steam Engines.

The *Electrical Review* in this issue has turned its experiences with the recent expedition of the Institution of Electrical Engineers into Switzerland into account, and in its leading article expresses itself as being much struck with the enterprise in which the development of the natural water power is being undertaken in that country. It refers in almost despairing language to the contrast exhibited between the behaviour of municipalities, banks, capitalists, and the public generally in respect to new electrical undertakings in Switzerland and those in our own country. The *Electrical Review* says:—

> We find a startling contrast with the state of things in Great Britain. We are accustomed to see our councils rising in their might to repel the so-called "monopolist," to resist great schemes for distribution of power over large areas at minimum prices, and to crush all native progress. We have seen them act the part of the "dog in the manger," securing powers to provide electrical supply, absolutely in order to prevent such supply being given! We have seen our great companies starving for capital, unable to carry out the extensions so urgently needed, while foreign-made machinery is pouring into our ports. No sooner is a tramway or light railway scheme projected than immediately meetings are held to devise ways and means to oppose the undertaking, often with a view of being bought off at ruinous prices—a process generally known as jobbery, to use the mildest term. We see our municipalities imposing arduous and unjust conditions on British contractors, and simultaneously giving orders abroad without a thought of controlling the wages there. The parrot-like cry of "disfigurement," so long cast in the way of tramway schemes, is happily becoming rare, as the public learns that the good of the many ought not to be sacrificed to the prejudices of the few; but still we see London destitute of electric tramways, and our toilers crowded in mephitic tunnels 15 to the compartment.
>
> In Switzerland there is nothing of this. Far from opposing engineering projects, the people welcome such, knowing the advantages that are certain to accrue to them; capital flows freely into the industry, and the far-seeing directors of the great banking concerns support the schemes. The beautiful and picturesque streets of the towns and villages, the inter-urban roads, and even the mountains themselves, have their well-laid tramways, operated for the most part by water-power.

The Electrical Review: Sept. 22nd, 1899.

Internationalisation of Service.
Elementary Treatments of Alternating-Current Problems.
Electric Traction in the North.
Electrical Engineers' Swiss Tour.
Animal Electricity.
Electrolysis of Hydrochloric Acid.
Progress in the Calcium Carbide Industry.
Recent Experiments with Steam on Common Roads.
Electro-Magnetic Separator.
A German Electro-Technical Institute.

The Electrical Review: Sept. 29th, 1899.

Electric Traction in Paris.
Installation of Steam Boilers.
Englewood and Chicago Storage Battery Line.
Phototherapeutics.
Some Notes on Single-Phase Motors.
Standards of Measurement.
Oerlikon Engineering Works.

The Electrical Review: October 6th, 1899.

Notes on Electrical Specifications.
Progress in the Acetylene Gas Industry.
Electric Driving of Printing Machinery.
Electricity *v.* Steam for Branch Railroad Lines.
Carlisle Corporation Electricity Works.

In this issue the author of the paper entitled "Progress in the Acetylene Gas Industry" expresses himself as follows on the prospects of the industry:—

> This review of recent progress in acetylene generation and utilisation shows that advancement is occurring, and that in certain directions the acetylene gas industry may undergo permanent and successful expansion.
>
> This expansion is unlikely to occur, however, in districts where coal-gas and electricity are already established, or where they can be favourably installed as illuminants; and those who desire the establishment of the carbide and acetylene gas industries upon a sound basis should recognise this limitation to their field of operations, and should, above all, discourage the circulation of false information concerning the relative costs of acetylene, coal-gas, and oil, when used for illuminating purposes.

The Electrician: September 22nd, 1899.

Contemporary Electrical Science.
Wireless Telegrams at Dover.
Centenary of the Electric Current.
The Majunna Meter.
Preliminary Note on the Variation of the Specific Heat of Water.

The Electrician: September 29th, 1899.

Darwen Corporation Electricity Works.
Thermal Relations in the Voltaic Cell.
Radiation from a Source of Light in a Magnetic Field.
Electricity Works Accounts (Blackpool).
Andrews' "Intercommunication" Office Telephones.

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In this issue the *Electrician* refers editorially to the difficulties associated with the Marconi system of telegraphy. It says :—

> Discouragement, however, need not result from the consideration that to extend the range of wireless signalling is to multiply its difficulties from interference. Although we know of no really satisfactory apparatus that would enable two stations in a scattered group of, say, 20 or more stations to signal exclusively, there are several well-understood principles that, with skilful development, might be applied to that end. The simplest method would seem to be that in which the ether waves would be cut off by metallic screens from every other direction than that straight to the desired goal. Another conceivable, but, as yet impracticable, plan would be to focus the rays by means of reflectors or refracting pitch lenses, after the manner of a search light. It is by no means certain however, that Marconi waves once started on a well-defined straight course would pursue "the same straight line." Most of the intervening objects of large dimensions, such as a hill or a large block of buildings, would probably exert an appreciable deviating influence.

The Electrician : October 6th, 1899.

Plymouth Corporation Electric Works.
Pollak-Virág High-Speed Telegraphy.
Hot-Wire Ammeters and Voltmeters.
Electricity Works Accounts (Newcastle).
Congress of Electricians at Como.
Some Recent Wireless Telegraph Patents.
Accidents at Blackpool Supply Station.
A New X-Ray Tube.

The Electrician : October 13th, 1899.

Contemporary Electrical Science.
Alderley and Wilmslow Electric Supply Works.
Signalling Without Contact.
Transformer Tests.
Electricity Works Accounts (Richmond).
The Chemical and Contact Theories.
Municipal Ownership in the United States.
Heat of Combination of Metals in the Formation of Alloys.
A New System of Train Lighting.
London County Council and Electric Traction.

In this issue of the *Electrician*, which has of late not been distinguished by many original articles the opinion is expressed editorially that little improvement has been made in the secondary battery apart from a reduction in weight and better mechanical finish. Our contemporary refers to a new accumulator battery as follows :—

> In the case of cells constructed by a process recently patented by M. Marcel Wuillot, the lead is subjected to the action of carbon dioxide, whereby more or less of its material is converted into carbonate of lead or white lead. The electrodes thus modified at the surface are immersed in an alkaline bath, such as a 5 per cent. ammoniacal solution, in which they undergo electrolysis. After remaining in the bath for a few hours exposed to electrolytic action, a complete re-conversion of the carbonate of lead is said to take place. At the negative plate it is transformed into spongy lead, while at the positive pole the inventor promises a hard and uniformly wrinkled skin of oxide of a closeness and consistency approximate with that of the original plate. The same process may, of course, be applied to a plate made of salts of lead produced artificially or mechanically, as in the Faure process. The trace of alkali which the plates must contain will probably prove beneficial at first, but, we think, it will soon get used up, and then we are left with the old lead—lead peroxide couple, with its familiar faults. What is wanted is a new couple, or the discovery of some substance whose addition to the old couple will neutralise the deleterious bodies formed during the working of the cell; and this substance must be one which can be broken up and re-formed continuously during charge and discharge, so that the working of the cell may be continuous.

Journal of Gas Lighting : September 19th, 1899.

Legality of the Wright System of Charging for Electricity.
Recent Noteworthy Judgments.
Chloride of Lime Process for Purification of Acetylene.

An article, written in the form of a review, dealing with Clause 22 of the Patents Acts, is of considerable importance. It deals with the obstructive maintenance of patents exemplified in one or two well-known instances connected with the manufacture of German dyes and the compulsory granting of licences.

Journal of Gas Lighting : September 26th, 1899.

Gas Acts of 1899.
The Quantity of Naphthalene in Gas.
British Association and Water and Sewage Analysis.
Progress in Artificial Lighting.

We are reminded of the fact in this issue (Von Oechelhaeuser on Progress in Artificial Lighting) that improvements in electric lighting have been at least balanced by progress in gas lighting, especially in connection with the Welsbach mantle. Our contemporary says :—

> The Nernst lamp has lately effected a reduction in the consumption of electric current of about 50 per cent., but the improvements in burners and mantles have gradually effected an economy in incandescent gas lighting of at least equal degree, compared with the results of the system in 1892. The advantage in cost of incandescent gas lighting remains, even when the Nernst lamp is taken for comparison. In all such comparisons, it should be remembered that an average illuminating power of 66 to 68 candles must now be assigned to an incandescent gas-burner, in place of the 44 candles the old burner was credited with.

Journal of Gas Lighting : October 3rd, 1899.

Dellwick Water Gas Process.
Conversion of Public Lamps for Incandescent Gas Lighting.
Lessons from Germany and Denmark.

Journal of Gas Lighting : October 10th, 1899.

Lessons from Germany and Denmark.
The Duties and Responsibilities of Authors.
Gas Acts for 1899.
Water Acts for 1899.
Electrical and Pneumatical Appliances for Incandescent Gas Lighting.
The "Ceraferin" Mantle.

AMERICAN.

Cassier's Magazine: September. — The chief feature of this issue is an article by Mr. Charles H. Jones, Assistant Locomotive Superintendent of the Midland Railway, under the title of "American Locomotives in Great Britain." Mr. Jones writes in terms of general approval on locomotives received by the Midland Company from the United States, but, to repeat his own words, "it remains to be seen whether they will live as long, be as cheap to maintain, keep as free from failures, and prove as economical in the consumption of fuel as their British competitors." There is in the issue besides, a very suggestive article "Some Reasons for the Excellence of American Machinery." The writer of it, Mr. H. B. Borisse, observes in its course:—"To the writer," he says, "the most striking feature in many of the European machinery exhibits in the World's Fair in Chicago was their academic design. Evidently they had been made with but a superficial knowledge of shop practice, and of what is needed for a machine to stand up to its work all the year round. With Americans, it is no uncommon usage to invite criticism of the design, and suggestions for improvements, from the men. Written forms are furnished for these, which are gone over with great care by the management. Some works go so far as to offer prizes and rewards for valuable hints and ideas from the workmen."

Railway Master Mechanic: September. —This elegant magazine contains an article expressing opinions on a matter that is causing some disquietude in this country: viz., the absolute value of purely theoretical technical education. In discussing this subject the magazine says:—

> The student should understand that the ideally educated man is he who has had the practical experience and has obtained the theoretical learning; then if he appreciates the proper relation of one to the other, and is guided in his work by such appreciation, he is quite sure to meet with success. It may be remarked that the demand is ever growing greater for the men who can so combine both branches of learning; and although the theoretical man may express disdain of the practical man and the practical man look similarly upon the man of theoretical attainments, each appreciates his own want. The position has been taken that the time spent in attending college is as good as lost, and while some might say, at first thought, that the idea was not a correct one, further consideration may possibly indicate differently. Assuming that the practical and theoretical should be combined for the best results, it naturally follows that, for proper appreciation of either, they should be associated as closely together as possible. Then it follows that a man should enter the practical side and carry the theoretical along with it. Some young men would be sufficiently far-seeing to carry both along with an even pace, but with a majority the experience would be obtained at the expense of theory. The colleges produce just the opposite condition, although it is their continual effort to bring the practical and theoretical as closely together as possible. A young man has the choice of three courses, viz., getting the practical and theoretical together (and for some this may be best); getting the theoretical and then the practical, with a college education first; or he may get the practical and then the theoretical. There have been successes secured from every one of these courses, but it is believed that the second has furnished the greatest number, and that it is the one to be preferred at present for the average young man. The strong objection to the last is that by the time a man has obtained some idea of the practical, he feels that his age or other incumbrance prohibits him obtaining the theoretical.
>
> Having obtained the college education, it is desirable that the young man get the practical education as quickly as possible, and to do this he should make compensation, and everything else, secondary to gaining experience; too frequently, the young man feels that he "knows it all" and bears himself accordingly, and his advancement awaits his learning the contrary. It should be appreciated also that even in the theoretical the college course merely starts the education, and a most important part of the teaching is where to find certain information when it is wanted.

Power, October.—Contained in this issue is an interesting account of the Snoqualmie Falls power plant, Washington, which develops 10,000 horse-power by a turbine installation on the Snoqualmie Waterfall, which has a fall of 270 ft. The installation, like almost all of a similar kind, has proved remarkably successful. *Power* says:—

> A really astonishing feature of the Snoqualmie Falls power plant, described elsewhere in this issue, is the use of what might reasonably be termed an experimental type of water-wheel. As mentioned in the article, the water-motors consist each of two three-tooth cycloidal gears which mesh and operate oppositely to the familiar rotary pump. That such an arrangement would run was obvious enough, but it seems a daring undertaking to equip a 10,000 h.-p. plant with the first production of the designer, which, we understand, was done in this case. Somebody evidently had the courage of pretty deep-seated convictions, which, we are glad to note, appear to have been justified by the performance of the water-wheels. The statement has been made, though not exactly "officially," that this cycloidal type of wheel developed an efficiency of a trifle over 90 per cent., which is a distinct advance over the best turbines thus far produced. In the absence of authentic data, however, this statement has not full weight. Another comparatively novel item in the equipment, though not unique, is the use of aluminium for station and line conductors. This practice appears to have already gained a solid footing in high-tension transmission work, and the reason for this, at existing prices for copper and aluminium is not difficult to find—an aluminium conductor of given resistance and length has about 48 per cent. of the weight of a copper wire of equal length and resistance. In alternating-current transmission aluminium wire is also advantageous electrically, because for a given conductivity the aluminium wire will have a much lower co-efficient of self-induction, so that the united effects of resistance and self-induction give a slightly smaller resultant. The advantage lies in the fact that aluminium wires of a given conductivity may be strung farther apart than copper wires of equal conductivity for a given "drop" in volts.

We notice that the method of conveying information by didactic conversations between imaginary personages, is becoming popular amongst some sections of technical American literature. We cannot say we much relish this means of acquiring knowledge ourselves, and will spare our readers any quotation of such a nature.

Machinery, September.—We consider this is by far the best *practical* engineering paper published in the world. It is hardly possible to excerpt from it excepting in a degree which would too seriously encroach on our space. We give the heads of a few of the more important articles:—"Familiar Subjects in Mechanics"; "Effect of

Soap in Hardening Water"; "Chemistry in Machine Shop Practice"; "A Revolving Tool Post"; "Machine Tools: their Construction and Manipulation"; "A Novel Air Compressor"; "Shop Kinks: a Department of Practical Ideas"; "Malleable Cast Iron"; "Making Irregularly Spaced Reamers"; "Practical Problems"; "Diagram of Pulley Weights"; "To Utilise the Cooling Water of Gas Engines"; etc., etc. Our contemporary teems with attractive illustrations, and is beautifully got up in every way.

Locomotive Engineering.—Among a number of articles of more or less interest on railway matters, *Locomotive Engineering* refers in somewhat indignant terms, for which it must be admitted there is some justification, to the reception which the American locomotives on British railways have met with in the columns of some English papers. Our contemporary says:—

> American locomotive builders do not follow the English practice of polishing and fine-finishing parts that do their work satisfactorily when covered with paint. But they finish the parts forming joints and journals as well as anything done on locomotives in any country. As a test of accurate finish of working parts, we should advise the Midland Railway people to take a set of side rods from an American engine, put one set above the other, and see how nicely mandrels will go down through the bearings. Do the same thing with an English-built engine, and let us know how the fitting compares.

In another part of the paper appears the following curious communication, which is represented to have come from England:—

> There is unfair work on the Midland. The Baldwin engines were made to work at 180 lbs., but the Midland have reduced them to 160 lbs. Why? They are having a private trial; a Baldwin engine, 18 ins. by 24 ins., 5 feet, 160 lbs., and a Midland engine, 18 ins. by 26 ins., 5 feet, 160 lbs. Of course, those two inches in the stroke are of vast importance, and give the Midland engine a great advantage. You will remember the Midland Company had Pullman cars, and proved (?) they were not as good as English carriages. Then the Midland had the Westinghouse brake, and proved (?) that it was not as good as the English vacuum. Now, the Midland has American engines, and are proving (?) that they are not as good as the English engines. Cars, brakes, and engines, one after the other. It is too clear. One can see that American appliances in England do not have fair treatment. If you ask either the Pullman, Westinghouse or Baldwin companies, no doubt they will agree that this is true.

It might be worth while to enquire what amount of truth, if any, is contained in the first allegation.

The Manufacturer, September.—This is the organ of the Manufacturers' Club of Philadelphia, an important organisation, which has no counterpart in this country, though it might be thought that the time has come when some common action for the promotion of general trade facilities should be taken. Its main article is one entitled "International Trade Opportunities" containing a series of useful hints adopted apparently from United States Consular Reports.

Scientific American.—We are not aware of any weekly newspaper in this country which possesses the eclectic scope together with the editorial authority of the *Scientific American*. In the highest class of technical journalism we are more than able to hold our own: but in journals of a discursive nature, as applied to science and mechanics, we must look beyond the Atlantic for an example. The *Scientific American* has been giving an exhaustive survey of the "Navies of the World," and that of the United States figures eighth in the list in the issue before us. According to a computation, whose results as specified in this review will come as a surprise to many, the United States takes fourth place after Great Britain in displacements, being ahead of Germany by some 3,000 tons. This proposition, we think, is one capable of being disputed; but returns of this nature are, as is well known, very fallacious.

The greater portion of the rare earths used for incandescent gas lighting are found in the United States. Another for a different purpose is now, it appears from the *Scientific American*, to be added to the number:—

Probably it is not generally known to manufacturing chemists in the United States that this country has vast resources in lithium mineral which have never been exploited. Lithium is classed as one of the rare elements, and is indeed rare in its metallic form, but its compounds are not rare in occurrence or in commerce. We do not know what their usefulness might be if their supply were large and cheap, but at present the use of lithium salts, especially the carbonate, is chiefly in the preparation of lithia water, which is used extensively for medicinal purposes in such diseases as rheumatism, due largely to an excess of uric acid in the system. There are some natural lithia waters, but a good deal of what is sold as such are artificial. The consumption of lithium carbonate for this purpose in the United States is variously estimated at from 40,000 to 200,000 pounds per annum, all of which is obtained from Germany. The average value of the salt at New York in 1898 was $4.22 per pound. Consequently, it is evident that there is a good business in sight for some one who will undertake its manufacture in this country, although it should not be expected that the price would keep up if the supply were increased largely.

It appears, from an extract we make from the same organ, that an interesting application of acetylene gas is being made in connection with subterranean engineering, as follows:—

> Two acetylene gas plants are being installed at two of the shafts of the Washington aqueduct tunnel. The plants are of 60 and 300 burners capacity respectively. In a report by Lieut.-Col. A. M. Miller, of the Corps of Engineers, United States Army, it is stated that the fumes and smoke from the blasting, added to the smoke from torches and lamps, rendered the atmosphere very offensive and discomforting to the workmen. Acetylene gas was selected as the most valuable and economical for the special purpose. The gas pipes are carried down shafts from the plants and run along the tunnel with cocks for burners every 30 feet, and this system suffices for the illumination of the tunnel for a distance of about 2 miles. Movable lights of several burners are connected with rubber hose and used to concentrate the light in the immediate vicinity of the work.

REVIEWS OF BOOKS AND CATALOGUES . . .

The Editor of FEILDEN'S MAGAZINE will be pleased to supply copies of any of the Catalogues noticed on this page, or to give further information.

The Evolution of the Steam Locomotive. By G. A. Sekon (second edition, enlarged): Railway Publishing Co. Ltd., 1899.

It would at first sight seem almost impossible to write anything new upon the history of railway locomotion, since scarcely any field of literature has been more completely covered. The work before us can make no other claims to originality save those which may be comprised in a lucid style, clear historical arrangement, and an amount of informative detail which, though copious, is never so much so as to become oppressive.

We have no means of knowing whether or not every type of early locomotive has been described and illustrated in this exhaustive work; but it is tolerably certain that very few have been omitted. The process of evolution as it can be traced in the volume is exceedingly interesting and instructive. From the crude experiment of Trevithick, the gradual development of the locomotive is traced through successive stages up to the masterpiece of mechanism we know as the railway locomotive of to-day.

A number of experimenters in railway locomotion were in the field before Stephenson took his position in the foreground, and it is certain, in the light of later research, that Stephenson's claims to original work in the evolution, at least, of railway engineering have been overestimated. This question is gone very fully into in the work before us, and with the reservation that its get-up might have been considerably improved, we are able to recommend it to the notice of our readers.

NEW CATALOGUES.

Ventilating and Electrical Apparatus. Matthews and Yates, Ltd., Cyclone Works, Swinton, Manchester.

This book contains some useful particulars concerning the electrical productions of a firm who have already made a distinguished name in the main branches of other than electrical engineering. The makers, in their preface to the Catalogue, express their confidence in the merits of their productions in this respect, having, as they state, made extensive experiments, as the result of which they can offer machines which they believe have no equal. Messrs. Matthews & Yates offer the services of their engineers gratuitously for the assistance of intending clients.

Tilestoneite. Lincolne & Co., North Wallace Street, Glasgow.

The speciality entitled in this handbook "Tilestoneite" is described as the subject of an important invention that has for its object the covering of the roofs and sides of bungalows, barracks, stores, and other buildings in which a comparatively cool temperature is desired in a hot country. Besides perfectly fulfilling its main purpose, Tilestoneite is stated to be impervious to the ravages of white ants. In the latter respect alone it will form a valuable innovation.

Pumps. Worthington Pumping Engine Company, 153, Queen Victoria Street, London.

This is the General Catalogue of the well-known Worthington Pumping Engine Company, and, it is hardly necessary to say, is quite representative of the reputation which its authors have attained. The copy we have is beautifully printed and bound in morocco.

Grinding and Polishing Machinery. Luke and Spencer, Ltd., Broadheath, Manchester.

This volume contains exhaustive illustrated particulars of Messrs. Luke & Spencer's Grinding and Polishing Machinery and Improved Consolidated Emery Wheels. The Catalogue is clear and explicit, and we can recommend it.

Engines, Boilers, and Cranes. Victor Coates & Co., Ltd. Belfast.

This is a Catalogue of Engines, Boilers and Cranes, with some types of special machinery. Altogether well worthy the attention of intending buyers of this class of plant.

Machine Tools. Webster and Bennett, Atlas Works, Coventry, England.

Messrs. Webster and Bennett point out in their introduction that this is a supplementary catalogue only, which has been issued in response to the demand for their tools. In the catalogue are described types of drilling machines, surfacing and boring lathes, sliding, surfacing, and screw-cutting lathes, capstan lathes, besides other machine tools for special uses. The makers state that all gears, racks, and worm gearing are cut from the solid, all bearing surfaces hardened and afterwards ground on Universal grinders, and all sliding surfaces scraped to a bearing. The catalogue is well arranged, and contains full information for intending buyers.

Hand-book of Steel Sections. —Dorman, Long and Co., Ltd., Middlesbrough, England.

This handsome volume will be found extremely useful as a table book in the offices of every constructional engineer. Its compilation must have entailed a vast amount of work which is presented, however, in a manner that does it full justice. The book consists of 182 pp., with blank memoranda pages at end, and contains a vast number of well-executed coloured lithographs of every conceivable variety of steel section. A quantity of formulæ are also given, together with some notes referring to constructional engineering, factors of safety, &c. We are sure that the "Hand-Book of Steel Sections" will be heartily welcomed and appreciated by its recipients, for it is very far removed from any ordinary trade catalogue.

XUM

Out of Print. . . .

An Explanation.

The Proprietors of FEILDEN'S MAGAZINE have been receiving numerous letters from many parts of the country complaining that the writers were unable to obtain copies of this Journal, and asking to have them forwarded direct from the Publishing Offices, at the same time taking, in some instances, exception to the premium which, owing to the encroachments on our binding reserve, we have been perforce obliged to impose on copies of No. 1. We append the following explanation. On communicating with Messrs. W. H. Smith & Sons, who gave us larger orders than we expected, and which were afterwards repeated, we were met with the reply we print below, which, however satisfactory to ourselves as indicating the extraordinary demand for the Magazine, we hardly expect will be equally so to those of our readers who were not fortunate enough in the first instance to secure their copies at the published price.

MESSRS. W. H. SMITH & SONS
To the PUBLISHER OF "FEILDEN'S MAGAZINE."

"*It should not be at all surprising to you to learn that so many important Bookstalls are without copies of your Magazine, as you confess your inability to supply more than one-fifth of our* REPEAT ORDER, *which was intended to supply some of the very stalls you now complain of as being without copies for sale.*

"*Every Bookstall in the country had a supply, and many Clerks sold out at once and applied for more, which we sent as long as our supplies lasted.*"

We have now adopted the obvious remedy, and have so augmented our printing and publishing resources, that we shall, as we trust, have no difficulty in meeting even an increased demand in future.

We have still a small reserve stock left of the second editions of Nos. 1, 2, and 3, which are not for sale singly to casual buyers, but can only be supplied to subscribers till exhausted. The art paper copies of No. 3 are quite out of print, but we can furnish copies of this issue on a good printing paper to complete subscribers' volumes. Early application is necessary.

From North, South, East, and West

a continual stream of tributes to "Feilden's Magazine" is flowing in. The annexed are conspicuous examples from two of Her Majesty's Ministers of Commerce.

BRITISH CONSULATE.
STETTIN.
September 16th 1899.

Sir,

I have to acknowledge receipt of your Magazine for September.

The illustrations and letterpress are far superior to those of any similar publication received at this Consulate, and the contributions are most interesting.

I shall be pleased to place it before users and buyers of machinery.

I am, Sir,
Your obedient Servant,

Ralph Bernal
H.M. Consul

The Editor,
Feilden's Magazine,
Temple Chambers,
London, E.C.

BRITISH CONSULATE-GENERAL,
HAMBURG,
September 16th, 1899.

Dear Sir,

I have to thank you for your letter of the 13th inst. accompanied by a copy of issue No.2 of "Feilden's Magazine", which, so far as I can see from a mere hasty perusal, is by far the most interesting and beautifully illustrated technical magazine I have ever seen in any country. I wish the Magazine and the patriotic purpose for which it is being published every success, and shall be glad to recommend it to anybody who takes an interest in technical subjects.

Yours faithfully,
William Ford.
H.B.M. Consul-General.

The Editor of "Feilden's Magazine",
London.

The October issue (No. 3) of FEILDEN'S MAGAZINE was pronounced by experts to be even superior to the far-famed first issue. Apart from the fund of useful information in other sections, it contained the following special articles:—"Governors: or, Control and Steadiness in Machinery," by Prof. Robert H. Smith; "Indigo" (the story of a threatened industry), by Lionel G. Radcliffe, Assistant Lecturer, etc., Municipal Technical School, Manchester; "Modern Telephony," by A. R. Bennett, M.I.M.E., the telephonic expert; "The Position in China," by J. Grant Birch. Also the continuation of the serial articles on "Acetylene Generators," by Prof. Vivian B. Lewes; "Machine Tools," by Ewart C. Amos (embodying descriptions of some modern British and American Tools); "The Building of a Great Railway" (the general and technical record of the G.C.R. Extension to London). All magnificently illustrated.

The September issue (No. 2) of FEILDEN'S MAGAZINE contained, in addition to a mass of other important matter, special articles, "On the Nature of the Fracture of Armour Plates," by Sir W. Roberts-Austen, K.C.B., etc.; "The Construction and Equipment of an Up-to-date Engineering Works," by T. Scott King, M.I.M.E.; "Piston and Ram Pumps," by Philip R. Björling; "A Revolutionizing Innovation in the Glass Industry," by Ludwig Grote; "Engineering in Britain and America," by Tom Mann; also continuations of our serial articles on Machine Tools, Acetylene Generators, and the Great Central Railway. You can still procure this issue at 1s. by making early application before it gets as scarce as No. 1.

The October issue (No. 3) on ART paper is out of print, but copies can be supplied (at 1/-) to complete subscribers' volumes, on good surface printing paper.

SEE NEXT PAGE.

XUM

Some few opinions out of hundreds from the daily Press on "Feilden's Magazine."

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The Daily Mail (London), in an article headed "Stands England where she did?" says:—

"The publication of FEILDEN'S MAGAZINE marks a new epoch in the history of technical publications. It deserves to rank with the best produced."

The Daily News (London) says:—

"The promoters are evidently determined that Britain is neither to be beaten in engineering nor in the efficiency of its trade and technical publications."

The London Sun concludes a remarkable article by saying:—

"There is nothing like it, or approaching it, in British engineering journalism. Its value to the engineering industry of the country can scarcely be over-estimated."

The Manchester Courier says:—

"Well written, well printed on good paper, with excellent illustrations, it is a worthy rival of the American industrial magazines, which have hitherto 'held the field.'"

The Sheffield Daily Telegraph says:—

"It is gratifying to learn that the whole of the issue of the first number was sold immediately after it was put on the market. The number has had to be reprinted since to satisfy the demand."

The Newcastle Leader devotes its principal leader to our motto "Militantly British," in the course of which it says:—

"For the artistic beauty of its illustrations, and for the variety and quality of its articles, it has no equal in England, and is on a level with the best works of the kind in the United States."

The Scotsman observes:—

"It follows the well-defined policy of furthering the particular interests of British engineering—a circumstance which, no less than the substantial merits of its contributions, must recommend it strongly to readers of technical literature throughout the world."

The Belfast News Letter says that the Magazine "could scarcely be improved."

The Edinburgh Evening News observes, in a leaderette:—

"The country's eyes are being opened to the dangers of our position. The first issue of FEILDEN'S MAGAZINE boldly declares itself to be 'Militantly British,' but it is 'the Imperialism of Commerce and Kinship, not of Militarism.'"

The Northern Whig (Ireland) says:—

"This high-class, representative, all-British engineering Magazine is certainly of very striking merit and full of splendid promise."

The British and Colonial Printer:

"It reaches the high-water mark of excellence."

Iron and Steel Trades Journal informs its readers that:—

"Mr. Theo. Feilden has in the past been identified with the production of trade papers which have been almost works of art; and in design, colouring, and general appearance, FEILDEN'S MAGAZINE is a thing of beauty."

The Nautical Gazette (New York):

"FEILDEN'S MAGAZINE is a success. It will be an eye-opener for Englishmen, but it will be worth a great deal to them."

The first number of ***Feilden's Magazine***, issued on August 1st last, contained among nearly 200 pages of other valuable matter, the following original articles by experts, specially contributed:

The Engineering Conference, 1899. Sir W. H. Preece, K.C.B., F.R.S.

Recent Characteristics of British Locomotive Engineering. C. Rous-Marten.

Acetylene Generators. Prof. Vivian B. Lewes.

The Iron Making Blast Furnace as an Ideal Power Producer. Horace Allen, C.E.

An Electrolytic Process for the Manufacture of Parabolic Reflectors for Searchlights and Locomotive Headlights. Sherard Cowper-Coles, M.I.M.E., etc.

Machine Tools. Ewart C. Amos, M.I.M.E.

Copper Steam Pipes. W. Edward Storey.

Owing to the exceptional demand for the issue, we can now only supply copies of No. 1 at 5/- each. Those desirous of commencing their Annual Subscriptions, to include No. 1, can do so by remitting 3/- in addition to the ordinary subscription of 12/-.